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SERVICE MANUAL
OSCILLOSCOPE
MODEL COS5100

KIKUSUI
ELECTRONICS CORP.

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* BLOCK DIAGRAM

* CIRCUIT SCHEMATICS

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Vert Preamp A1, Cal & CRT A4 ..... [1]

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Sweep & Horiz Amp A5 ..... [3]

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* REPLACEABLE PARTS ..... 1/26 ~ 26/26

* MECHANICAL ASSEMBLY DRAWINGS

FRONT PANEL ASSEMBLY 317443

FRONT FRAME ASSEMBLY 316099

REAR PLATE ASSEMBLY 317445

CRT ASSEMBLY 317446

CIRCUIT BOARD ASSEMBLY 317447

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COVER & HANDLE ASSEMBLY 317449

1. GENERAL

1.1 Description

Kikusui "5000 Series" Model COS5100 Oscilloscope responds to the customers needs in quality of performance, efficiency, function, design, and cost.

The COS5100 oscilloscope is rugged, highly reliable and a multi-purpose 3-channel 8-trace portable oscilloscope with a 6-inch Domed-mesh type 18 kV post deflection acceleration cathode-ray tube and with fine red internal graticule.

The vertical axis has a maximum sensitivity of 1 mV/DIV, a frequency response of up to 100 MHz -3dB, and a maximum sweep speed of 2 ns/DIV. A waveform magnification function with sweep delay is incorporated for real A, B dual time-base, therefore, this scope has many convenient features and specal functions which make it an ideal instrument for diversified types of research and development of electronic equipment or circuitry. It can also be efficiently used in production line maintenance and service applications. The features of the COS5100 Oscilloscope can be summarized as follows.

1.2 Features

(1) Compactness, light-weight, ruggedness and simple-design:

The diecast frame provides compactness light-weight and ruggedness. The superior structural design is the ultimate in simplicity.

(2) Ease of operation:

Light torque lever switches and pushbutton switches are used. These and other controls are laid out in the most convenient locations making the oscilloscope extremely easy to operate.

(3) High-brightness CRT, high acceleration voltage. (18 kV):

The high acceleration voltage and high beam-efficiency of the 80 mm × 100 mm rectangular CRT ensures a bright trace for high speed sweep observation.

(4) Multi-mode display system:

CH1. CH2. ADD. CH3 (trigger view) any combination or all the channels may be viewed simultaneously with a simple adjustment of the MULTI-MODE display buttons. Maximum 8 trace displaying is possible with the ALT sweep function.

(5) Dynamic bias circuitry (PAT. PEND):

The energy-saving design makes use of automatic electric power consumption control circuitry so that, when the indicated signal waveforms are small or the frequency components are low operations are performed with minimum use of electricity.

(6) High stability and low-drift:

The new circuits are desinged and adopted with a temperature drift-compensation circuitry for minimizing any kind of drift and stable DC balance.

(7) High sensitivity and wide frequency bandwidth:

The maximum vertical sensitivity is 1 mV/DIV (with ×5 MAG) 20 MHz or greater -3 dB and 5 mV/DIV at 100 MHz or greater -3 dB.

(8) High input impedance:

The input impedance of CH1, CH2 is 1 MΩ ±1%, 25 pF ±2 pF and CH3 (trigger view) is 1 MΩ ±2%, 25 pF ±2 pF.

(9) "VERT MODE" TRIGGER FUNCTION:

When in the VERT MODE trigger mode, stable triggering can be attained even when the signals of CH1, CH2 are not time related.

(10) Maximum sweep speed 2 ns/DIV:

With ×10MAG function the highest sweep speed of 20 ns/DIV can be multiplied by a factor of 10 to a attain a maximum sweep speed of 2 ns/DIV.

(11) Alternate sweep:

The A sweep and the delayed sweep can be viewed simultaneously in the alternate mode.

(12) 2 channel X-Y operation:

CH3 may be used as EXT HORIZ input allowing CH1 and CH2 to be used as vertical inputs for DUAL channel X-Y displays.

(13) Trigger level lock:

A new trigger level lock circuit which controls the trigger signal and performs automatic adjustments of the trigger level, even for VIDEO signals and signals of large duty cycles. This is an operation step-saver which eliminates the need for manual trigger level adjustment.

(14) TV sync. triggering:

The COS5100 has a sync separator circuit, which allows triggering for TV.V signal and TV.H signal. It is automatically switched with the TIME/DIV control.

(15) Variable holdoff function:

Digital and other signals with complex repeating periods which resist triggering can be stably triggered with a simple adjustment of the hold off level.

(16) Linear focus:

Once the beam focus is adjusted, it is automatically maintained in this state regardless of changes in intensity.

(17) CH1 signal output:

The CH1 signal output allows connection to frequency counters and other devices at all levels.

2. SPECIFICATIONS

Vertical axes

Item	Specification	Remarks
CH1 and CH2		
Sensitivity	5 mV/DIV - 5 V/DIV 1 mV/DIV - 1 V/DIV (when ×5 MAG)	1-2-5 sequence, 10 positions
Sensitivity accuracy	±3% ±5% (when ×5 MAG)	10 to 35°C (50 to 95°F), 1 kHz, at 4 or 5 DIV
Variable vertical sensitivity	To 1/2.5 or less of panel-indicated value	
Frequency bandwidth	DC - 100 MHz (-3 dB) DC - 20 MHz (-3 dB), when ×5 MAG AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 8 DIV.
Input coupling	AC, DC, GND	
Input impedance	1 MΩ ±1%, 25 pF ±2 pF	
Allowable input voltage	300 V (DC + AC peak)	Frequency 1 kHz or lower
Square wave characteristics	Overshoot: Not greater than 5% (at 10 mV/DIV range) Other distortions: Not greater than 3% (at 10 mV/DIV range)	Other ranges: Add 3% VARIABLE knob is CAL'D position. 10 to 35°C (50 to 95°F)
CH3	EXT input terminal used in common.	
Sensitivity	0.1 V, 0.5 V/DIV	
Sensitivity accuracy	±3%	10 to 35°C (50 to 95°F), at 8 DIV
Frequency bandwidth	DC - 100 MHz (-3 dB) AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 8 DIV.

Item	Specification	Remark
Input coupling	AC, HF REJ, TV, DC	
Allowable input voltage	100 V (DC + AC peak)	Frequency 1 kHz or lower
Square wave characteristics	Overshoot: Not greater than 10% Other distortions: Not greater than 5%	10 to 35°C (50 to 95°F)
Rise time	Approx. 3.5 nsec (Approx. 17.5 nsec when ×5 MAG)	
Signal delay time	Approx. 20 nsec (with delay cable of approx. 100 nsec)	The displayed portion preceding the triggering point
Delay time differences among channels	Not greater than ±0.5 nsec among CH1, CH2 and among another channel ±2.0 nsec	
Polarity change	CH2 only	
DC balance shift	±0.5 DIV (±2.0 DIV when in ×5 MAG)	
Display modes	Simultaneous displays of CH1, ADD (CH1 + CH2), CH2, CH3 are possible in any combination. ALT, CHOP: Switchable X-Y: TIME/DIV switch change to [X-Y] [CH3 HOR] and SOURCE switch to [X-Y]	Simultaneous X-Y displays of CH1, CH2, ADD and CH3, at CHOP MODE
Chopping repetition frequency	500 kHz/number of displayed channels ±40%	
Common mode rejection ratio	50:1 or better at 50 kHz, sinusoidal wave	When sensitivities of CH1 and CH2 are set equal
CH1 signal output	Approx. 50 mV/DIV at 50Ω termination	Approx. 100 mV/DIV at open
CH2 INV BAL	Balanced point. Not greater than 1 DIV	Reference at center graticule

Item	Specification	Remark
Isolation between channels	At least 1000:1 at 50 kHz At least 30:1 at 100 MHz	At 5 mV/DIV range
Linearity	Within ±0.1 DIV when signal with 2 DIV amplitude in screen center is moved to upper or lower.	

Triggering

Item	Specification	Remark
Internal trigger selection (INT TRIG)	CH1, CH2 and "VERT MODE" (Trigger source is selected depending on the vertical operation mode.) When in ADD, the CH1 input signal is used at the trigger source signal.	VERT MODE function works in ALT sweep MODE between CHs and single CH alone operation
A trigger Signal source	INT, LINE, EXT, EXT/5	
Coupling	AC, HF REJ, TV, DC	
Polarity	+ or -	
Sensitivity	DC - 10 MHz: 0.4 DIV (0.04 V) 10 - 100 MHz: 1.5 DIV (0.15 V) Video signal: 2.0 DIV (0.2 V) AC coupling: Attenuates signal components of lower than 10 Hz. HF REJ: Attenuates signal components of higher than 50 kHz.	The values enclosed in the parenthese are the input sensitivities when in the EXT trigger mode.
B trigger Signal source	B trigger source is A trigger source.	

Item	Specification	Remarks
EXT trigger input	CH3 input terminal used in common	
Input impedance	1 MΩ ±2%, 25 pF ±2 pF	
Maximum allowable input voltage	100 V (DC + AC peak)	Frequency 1 kHz or lower
AUTO mode	Satisfies the trigger sensitivity specification for signal repetition frequency of 50 Hz or over.	
LEVEL LOCK	Satisfies the value of the above trigger sensitivity plus 0.5 DIV (0.05 V) for signal of duty cycle 20:80 and repetition frequency 50 Hz - 80 MHz.	

Horizontal axis

Item	Specification	Remarks
Horizontal axis display	A, ALT (A INT), B (DLY'D)	
A sweep		
Sweep mode	AUTO, NORM, SINGLE	
Sweep time	20 nsec/DIV - 0.5 sec/DIV 2 nsec/DIV - 50 msec/DIV (when in "×10 MAG")	1-2-5 sequence, 23 positions
Sweep time accuracy	±3%	10 to 35°C (50 to 95°F)
Variable sweep time	To 1/2.5 or slower of panel-indicated value	
Holdoff time	Continuously variable to 2 times or over of sweep length (time) at 20 nsec/DIV - 10 msec/DIV ranges	

Item	Specification	Remarks
B sweep		
Delay system	Continuous delay or triggered delay	
Sweep time	20 nsec/DIV - 50 msec/DIV 2 nsec/DIV - 5 msec/DIV (when in "×10 MAG")	1-2-5 sequence, 20 positions
Sweep time accuracy	±3%	10 to 35°C (50 to 95°F)
Delay time	0.2 µsec - 5 sec	
Differential delay time accuracy	±3% of multidial-indicated value (except 0 - 0.50) ±4% of value read on graticule	
Delay jitter	1/10,000 or less $\frac{\text{B sweep time}}{\text{A sweep time}} \times \frac{\text{jitter width}}{10\ \text{DIV}}$	Jitter width 1.0 DIV or less at A: 1 msec/DIV B: 1 µsec/DIV
Sweep magnification	10 times (maximum sweep time 2 nsec/DIV)	Both A and B
Magnified sweep time accuracy	0.1 µsec/DIV - 0.5 sec/DIV ranges: ±5% 20 nsec/DIV - 50 nsec/DIV ranges ±8%	10 to 35°C (50 to 95°F)
Linearity	±3% ±5% (when in "×10 MAG)	
CH3 sweep (CH3 HOR)	CH3 (EXT TRIG) input signal is used as sweep trigger signal. (For vertical axes, any combination of CH1, ADD (CH1 + CH2), CH2, and CH3 can be simultaneously displayed in CHOP mode.)	
Sensitivity	0.1 V, 0.5 V/DIV	Same as CH3
Sensitivity accuracy	±3%	Same as CH3

Item	Specification	Remarks
Frequency bandwidth	DC - 2 MHz (-3 dB)	With reference to 50 kHz, 10 DIV
Phase difference between vertical axes	Not greater than 3° at DC - 100 kHz	
X-Y mode	X-axis: CH1 input signal Y-axis: CH2 input signal	
Sensitivity	5 mV - 5 V/DIV	Same as CH1
Sensitivity accuracy	±4% NORM ±5% (when in "×10 MAG")	10 to 35°C (50 to 95°F), 1 kHz, at 4 or 5 DIV
Frequency bandwidth	DC - 2 MHz (-3 dB) AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 10 DIV
X-Y phase difference	Not greater than 3° at DC - 100 kHz	

Z axis

Item	Specification	Remarks
Sensitivity	3 Vp-p (Trace becomes brighter with negative input.)	
Frequency bandwidth	DC - 5 MHz	
Input resistance	5 kΩ ±10%	
Allowable input voltage	50 V (DC + AC peak)	AC: 1 kHz or lower

Calibration voltage

Item	Specification	Remarks
Waveform	Positive-going square wave	
Frequency	1 kHz ±5%	
Duty ratio	Within 45:55	
Output voltage	2 Vp-p, ±2%	
Output resistance	Approx. 2 kΩ	

CRT

Item	Specification	Remarks
Type	6-inch rectangular CRT, internal graticule	
Fluorescent screen	P31 phosphor	
Acceleration voltage	Approx. 18 kV	
Effective screen size	8 × 10 DIV	1 DIV = 10 mm (0.39 in.)
Graticule	Internal graticule, continuously adjustable illumination	

Mechanical specifications

Item	Specification	Remarks
Dimensions of mainframe	280 W × 150 H × 370 D mm (11.02 W × 5.91 H × 14.56 D in.)	
Maximum dimensions	340 W × 200 H × 450 D mm (13.39 W × 7.87 H × 17.72 D in.)	
Weight	Approx. 7.5 kg (16.5 lbs)	

o Line power requirements

Voltage: 100 V, 115 V, 215 V, 230 V; with 10% allowance.
Selectable by connector change

Frequency: 50 Hz or 60 Hz

Wattage: Approx. 44 VA

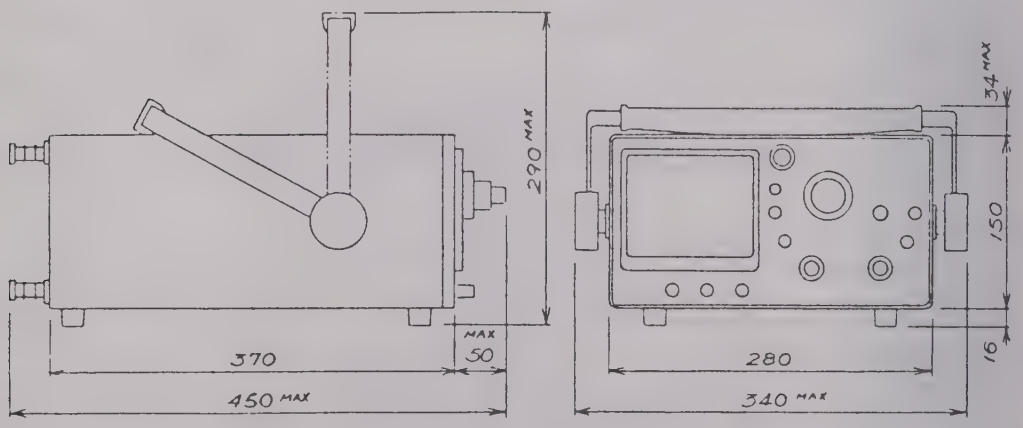
o Operating environment

To satisfy specifications: 5 to 35°C (41 to 95°F), 85% RH

Maximum operating ranges: 0 to 40°C (32 to 104°F), 90% RH

o Accessories

P100-S probes (10:1, 1:1, 1.5 m)	(89-03-0330)	... 2
942A terminal adaptors	(W4-986-011)	... 3
Fuse (1 A or 0.5 A)	(99-02-0100) (99-02-0101)	... 1
Power cord	(85-10-0120)	... 1
Instruction manual	( )	... 1



o Specifications and contents on this manual are subject to change without notice.

3. CIRCUIT DESCRIPTION

3.1 General

The overall circuit structure of the oscilloscope is as depicted with a block diagram in Figure 3-1. It is comprised of a vertical deflection circuit for moving the beam spot in the Y-axis direction on the CRT screen, a horizontal deflection circuit for moving the beam spot in the X-axis direction, a CRT circuit for operating the cathode-ray tube, a calibrator circuit for calibrating the instrument probe, and a power supply circuit for supplying powers to the various circuits of the instrument.

The vertical amplifier circuit has two mutually independent preamplifiers (CH1 and CH2), a vertical switching circuit, a delay line, and a vertical output amplifier.

Each of the preamplifiers amplifies or attenuates its input signal of several millivolts to several hundreds volts into a level suitable for handling by the subsequent stages. The conditioned vertical signals are sent to the vertical switching circuit. The trigger signals also are picked off at this stage.

The vertical switching circuit electronically switches the vertical signals received from the CH1 and CH2 preamplifiers and the CH3 signal received from the trigger generator. The switched signal is fed via the delay line circuit to the vertical output amplifier. The trigger signals also are switched and fed as internal trigger signals to the trigger generator.

The vertical output amplifier amplifies the vertical signal, which is received through the delay line circuit, into a level of several volts to several tens volts for vertically deflecting the beam spot on the CRT screen.

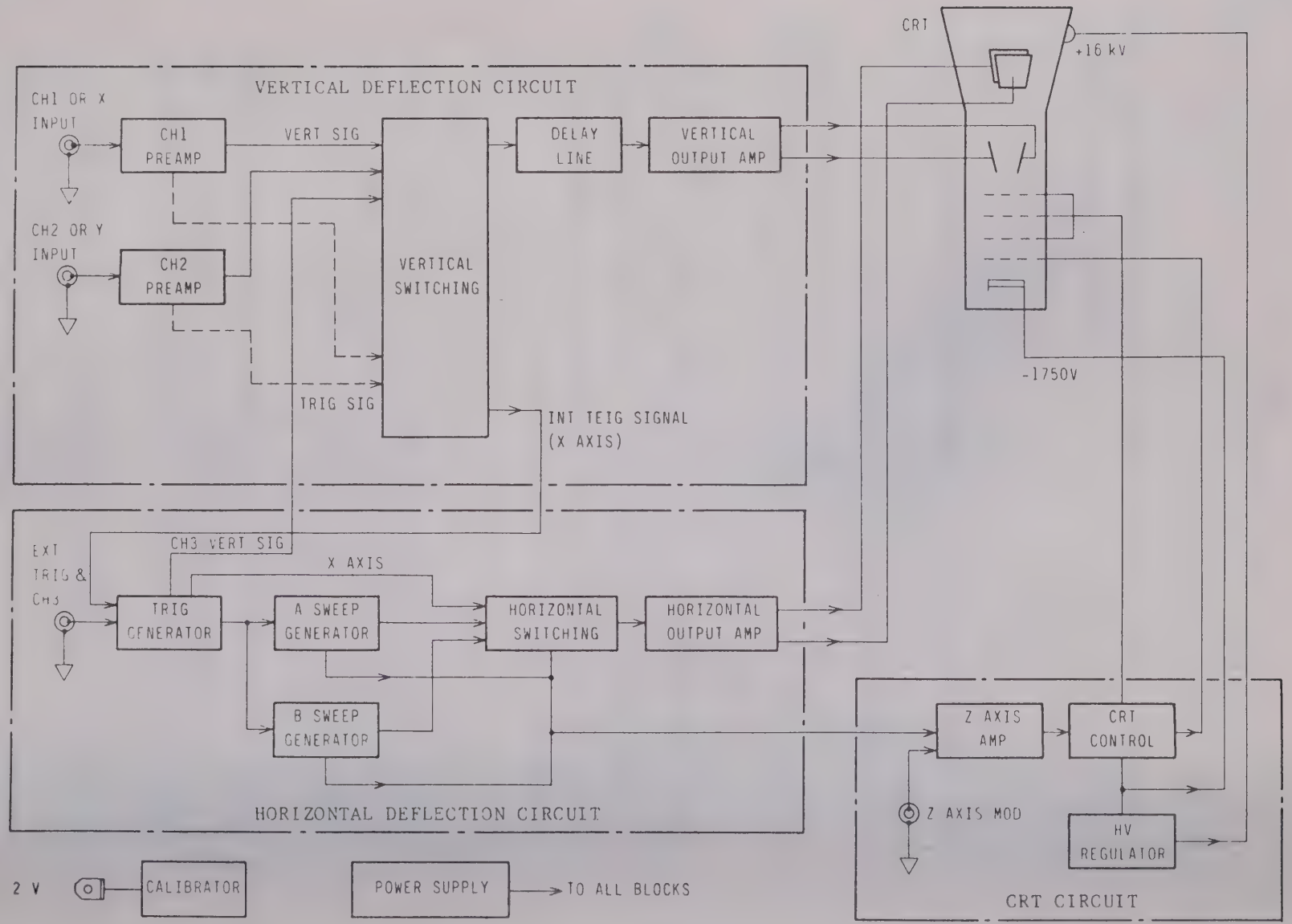

CRT
+16 kV
VERTICAL DEFLECTION CIRCUIT
CH1 OR X INPUT
CH1 PREAMP
VERT SIG
DELAY LINE
VERTICAL OUTPUT AMP
CH2 OR Y INPUT
CH2 PREAMP
VERTICAL SWITCHING
TRIG SIG
INT TEIG SIGNAL (X AXIS)
-1750V
EXT TRIG & CH3
CH3 VERT SIG
X AXIS
TRIG GENERATOR
A SWEEP GENERATOR
HORIZONTAL SWITCHING
HORIZONTAL OUTPUT AMP
B SWEEP GENERATOR
HORIZONTAL DEFLECTION CIRCUIT
Z AXIS AMP
CRT CONTROL
Z AXIS MOD
HV REGULATOR
CRT CIRCUIT
2 V
CALIBRATOR
POWER SUPPLY
TO ALL BLOCKS

Figure 3-1

The horizontal deflection circuit has a trigger generator, sweep generator, a horizontal switching circuit, and a horizontal output amplifier.

The trigger generator receives the internal trigger signal from the vertical switching circuit or an external trigger signal from the EXT TRIG (CH3) INPUT terminal and amplifies the signal and generates a trigger pulse signal.

The A sweep generator is driven by the trigger pulse signal of the trigger generator and produces the A sawtooth signal. The sweep generator produces a sawtooth signal even when no trigger pulse is applied to it (the AUTO mode).

The B sweep generator produces the B sawtooth signal, being driven by the delayed sweep start signal produced with respect to the A sawtooth signal when in the continuous delay mode (HOR DISPLAY: B). When in the synchronized delay mode (HOR DISPLAY: B TRIG'D), the B sweep generator generates the B sawtooth signal being driven by the trigger pulse signal of the trigger generator which follows the above delayed sweep start signal.

The horizontal switching circuit electronically switches the sawtooth signals received from the A and B sweep generators and the CH1 & CH3 HOR signal received from the vertical switching circuit when in the X-Y mode of operation, and sends the resultant signal to the horizontal output amplifier.

The horizontal output amplifier amplifies the output signal of the horizontal switching circuit to a level of several volts to several tens volts in order to drive horizontally the beam spot on the CRT screen.

The CRT circuit is comprised of a high voltage generator (the HV regulator) to accelerate the electron beam emitted from the CRT cathode, a Z-axis amplifier to amplify the signal to blank out the return traces, and a CRT control circuit to operate the CRT tube in its optimal state.

The HV regulator provides a -1.75 kV voltage which is applied to the CRT cathode to accelerate the electrons emitted by it and a 16 kV voltage which is used as a post-acceleration voltage to accelerate further the electrons after passing the vertical and horizontal deflection plates.

The Z-axis amplifier amplifies the unblanking signals received from the A and B sweep generators and the trace intensity control signal to a level of several tens volts in order to be applied to the 1st grid (control grid) of the CRT via the CRT circuit.

The CRT circuit provides the various voltages for the CRT electrodes so that the CRT operates in an optimal state, displaying sharply-focussed less-distorted signal waveforms. It also conditions the signals received from the Z-axis amplifier and other circuits into levels suitable for application to the CRT.

3.2 Preamplifiers

The CH1 preamplifier amplifies the signal of the CH1 or X input terminal. The CH2 preamplifier amplifies the signal applied to the CH2 or Y input terminal. A detailed block diagram is shown in Figure 3-2.

- Input coupling switch:

The input coupling switch (S101/S201) selects the input coupling mode for AC, GND, or DC. When the GND state is selected, the preamplifier input is isolated from the input terminal and is grounded so that the base line (0 level) on the CRT screen can be checked.

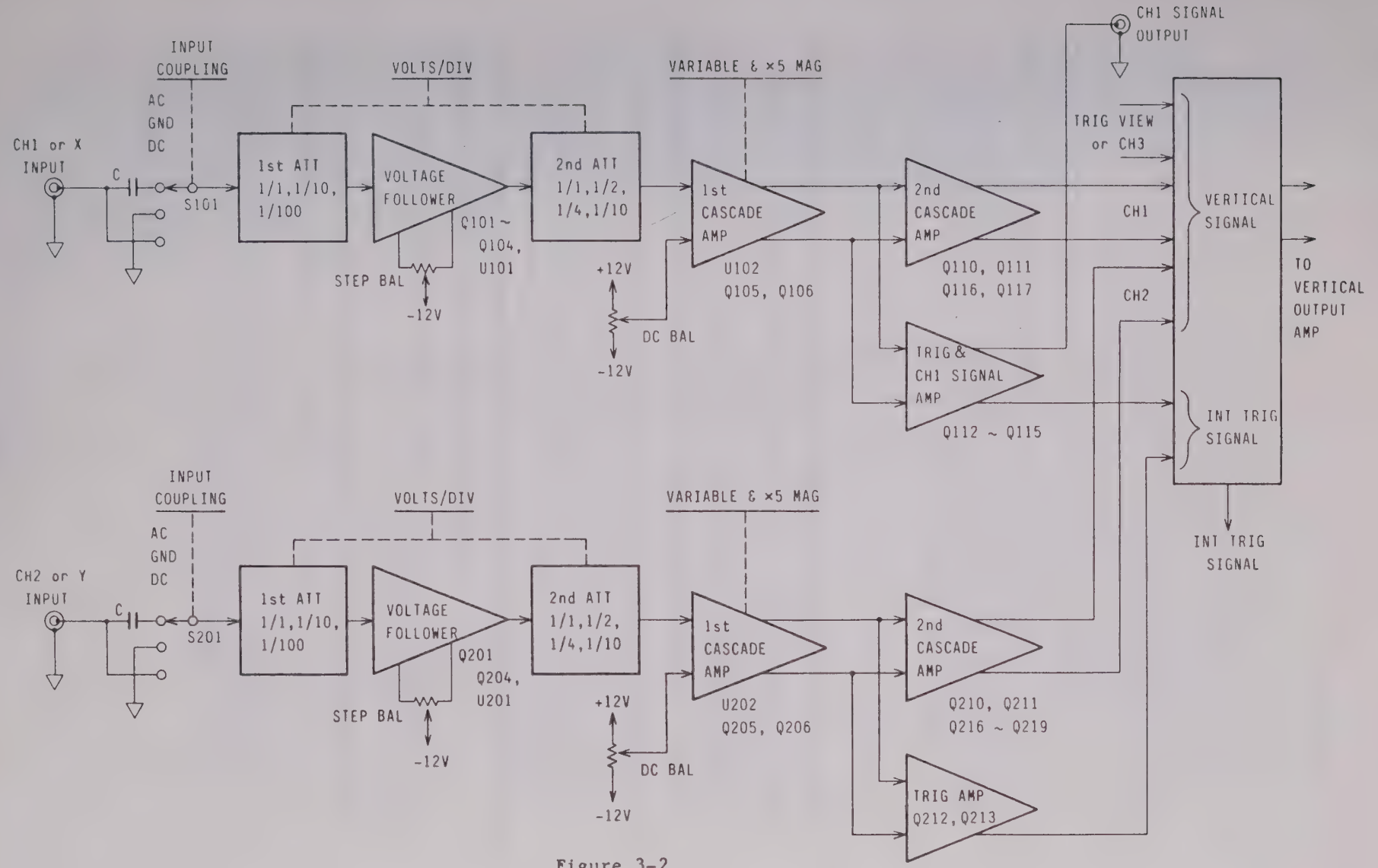

CH1 SIGNAL OUTPUT
INPUT COUPLING
AC
GND
DC
VOLTS/DIV
VARIABLE & ×5 MAG
CH1 or X INPUT
C
S101
1st ATT 1/1,1/10, 1/100
VOLTAGE FOLLOWER
Q101 ~ Q104, U101
STEP BAL
-12V
2nd ATT 1/1,1/2, 1/4,1/10
+12V
DC BAL
-12V
1st CASCADE AMP
U102
Q105, Q106
2nd CASCADE AMP
Q110, Q111
Q116, Q117
TRIG & CH1 SIGNAL AMP
Q112 ~ Q115
TRIG VIEW or CH3
CH1
CH2
VERTICAL SIGNAL
TO VERTICAL OUTPUT AMP
INT TRIG SIGNAL
INT TRIG SIGNAL
CH2 or Y INPUT
S201
Q201 Q204, U201
Q202 Q205, Q206
Q210, Q211
Q216 ~ Q219
TRIG AMP Q212, Q213

Figure 3-2

o Attenuators:

Each of the CH1 and CH2 attenuator circuits consists of two attenuators: The 1st attenuator for 1/1, 1/10 and 1/100, and the 2nd attenuator for 1/1, 1/2, 1/4 and 1/10. By switching these attenuators with the VOLTS/DIV switch (S102/202), the signal can be attenuated for a total range of 1/1 to 1/1000 in 10 steps.

The 1st attenuator directly attenuates the signal received from the input coupling switch and feeds the attenuated signal to the voltage follower. The 2nd attenuator attenuates the low-impedance output signal of the voltage follower and feeds the attenuated signal to the 1st differential cascade amplifier.

o Impedance converter:

The impedance converter provides with its source follower (Q101/Q201) a high input impedance to prevent loading effect on the 1st high-impedance attenuator circuit and provides with its emitter follower (Q103, Q104/Q203, Q204) a low output impedance to drive the 2nd attenuator. U101/U201 compensate for DC offset (STEP BAL) and DC drift.

o 1st differential cascade amplifier:

The 1st differential cascade amplifier is comprised of an emitter follower (U102-1/2, U202-1/2), a differential current amplifier (U102-2/2, U202-2/2) whose emitters are mutually connected through a resistor, and a voltage-to-current converter (Q105/Q106, Q205/Q206) which converts the amplified mutually-opposite-phase collector current into a voltage signal.

This amplifier also has a VARIABLE circuit for continuously-variable adjustment of the sensitivity between two mutually adjoining vertical deflection sensitivity ranges selected by the VOLTS/DIV switch and the ×5 MAG switch for magnifying the vertical sensitivity by 5 times to attain a sensitivity of 1 mV/DIV.

o VARIABLE circuit:

The VARIABLE circuit continuously-variably adjusts the vertical sensitivity by shunting with potentiometer RV105/RV205 a part of the collector current amplified by U102-2/2 or U202-2/2. That is, with potentiometer RV105/RV205, the gain of the amplifier can be adjusted (attenuated) down to a factor of 1/2.5 or less.

o ×5MAG circuit:

The ×5MAG function is to increase the vertical sensitivity by 5 times by switching the emitter resistor of the differential current amplifier.

o 2nd differential cascade amplifier:

The 2nd differential cascade amplifier (Q110, 111, 116, 117, or Q210, 211, 216 - 219) amplifies the output of the 1st differential cascade amplifier to a sufficient level for driving the vertical switching circuit. The grounded-base stage (Q116, 117/Q216 - 219) of this cascade amplifier has a function of preventing the switching signal of the vertical switching circuit from being returned to the preceding stage and mixed into the trigger signal or the CH1 output signal. For the CH2 signal, this amplifier has a function of inverting its polarity. This polarity inverting function is accomplished by switching with the INV switch the base grounding stages of Q216/217 and Q218/219 whose collectors are connected being mutually crossed.

The current signal for vertical positioning of the trace on the CRT screen is added to the amplified collector current signal of Q110/Q111 or Q210/Q211, being controlled by potentiometer RV115/RV215 of the positioning circuit.

Different from the case of the 1st differential cascade amplifier, the output signal of the 2nd differential cascade amplifier is fed directly in the form of the current signal to the diode gate of the vertical switching circuit.

o Trigger signal amplifier (and CH1 signal output amplifier):

This circuit amplifies with its Q112/Q113 or Q212/Q213 the signal Picked off from the 2nd differential amplifier, and converts with its Q114 the collector output of Q112 into a low-impedance CH1 output signal which is fed to J15-C. The collector output signal of Q113 or Q213 is fed as a trigger signal. In order to prevent the switching signal of the internal trigger switching circuit from being mixed into the CH1 output signal, the base ground stage (Q115) is connected to the collector of Q113 for providing the signal for the internal trigger swithcing circuit.

3.3 Vertical Switching Circuit

The vertical switching circuit is comprised of a vertical signal switching circuit (diode gate circuit) which electronically switches the vertical signals received from the CH1 and CH2 preamplifiers and the CH3 signal received from the TRIG generator, an internal trigger signal switching circuit which electronically switches the trigger signals, and a switching logic circuit which controls these switching circuits. The vertical signal switching circuit is, as shown in Figure 3-3, comprised of a diode gate circuit, an ADD BAL circuit, and a switching buffer circuit which receives the signal from the diode gate circuit.

o Diode gate circuit:

The diode gate circuit (CR113 - 116, CR213 - 216, CR301 - 304) selects the CH1 - CH3 signals being controlled by the siganl of the switching logic circuit according to the mode selected by the VERT MODE switch (S401).

For example, when the VERT MODE switch is set at CH1, the CH1 control signal becomes the Hi state, and the CH2 and CH3 control signals become the Lo state. Consequently the output signal of the CH1 preamplifier is fed through CR113 and CR116 to the switching buffer circuit consisting of Q403 and Q404. The signals of the other channels are fed through respective diodes CR214/215 and CR302/303 to the control circuit. Thus, the signal of CH1 alone is fed to the switching buffer circuit and the signals of the remaining channels are blocked.

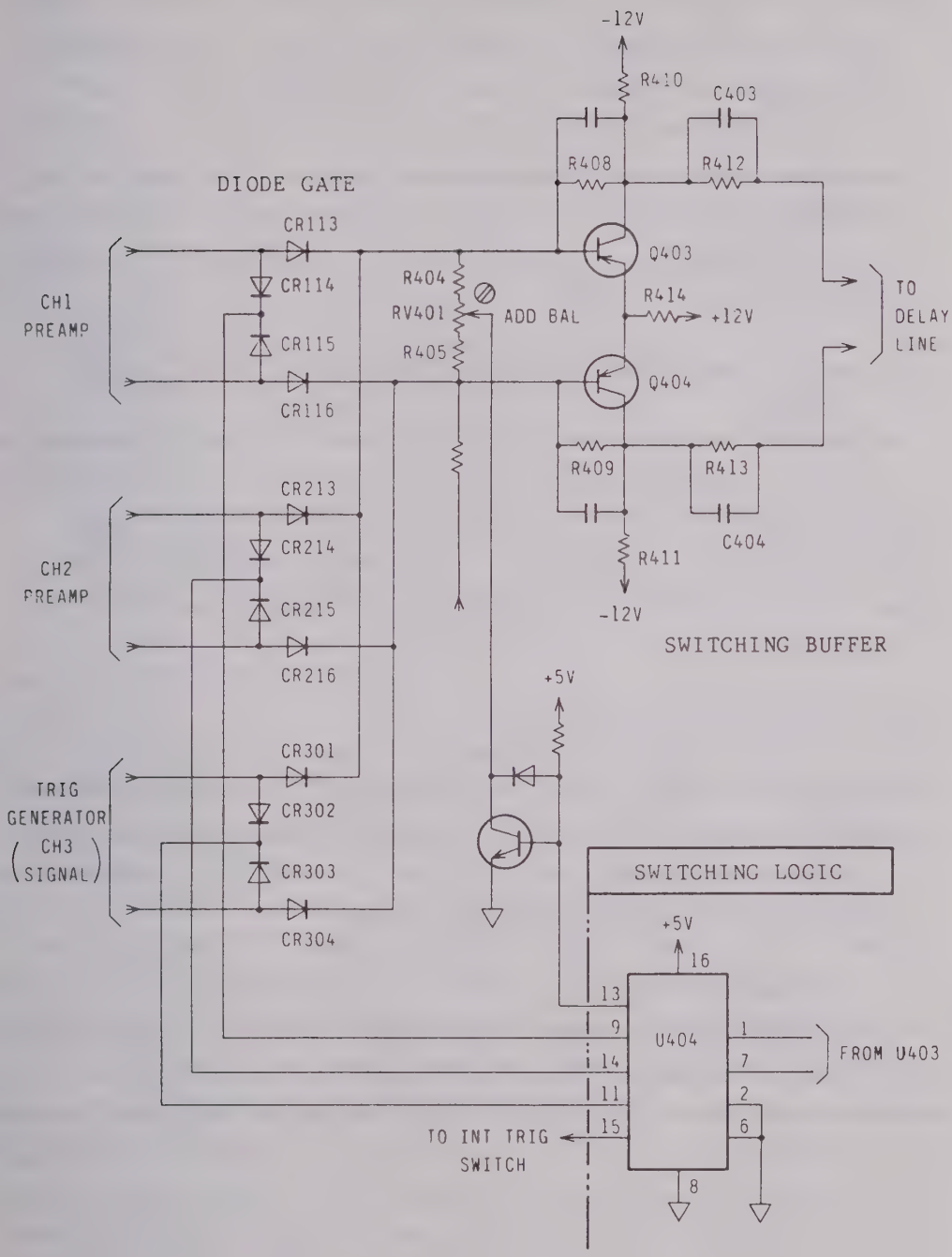


Figure 3-3 Vertical switching circuit

o ADD BAL circuit:

When the ADD mode is selected by the VERT MODE switch, the control signals of both CH1 and CH2 become the Hi state, the signals of the CH1 and CH2 preamplifiers are fed through CR113/116 and CR213/216 to the switching buffer circuit, and the two signals are fed as their sum signal to the output circuit. The function of the ADD BAL circuit is to compensate for the DC balance shift caused by the above addition operation, with its ADD BAL control (semi-fixed potentiometer RV401).

o Internal trigger signal switching circuit:

The internal trigger signal switching circuit directly controls, with the control signals from the switching logic circuit, the diode gate circuit (CR404 - 407) which is similar to the vertical signal switching circuit. The trigger signal which has passed the diode gate circuit is delivered as the internal trigger signal via connector P19.

o Switching logic circuit:

The switching logic circuit is comprised of a vertical switching logic circuit which controls the vertical signal switching circuit and an internal trigger switching logic circuit which controls the internal trigger signal switching circuit.

The vertical switching logic circuit is comprised of a ring counter which is consisting of two flip-flop ICs (U403-1/2, 2/2) with preset/clear terminals and a code converter (U402) which receives the ring counter output and generates control signals for individual channels. Switching can be done for any combination of channels by setting Hi or Lo state the preset/reset terminals of the ring counter. The code-converted control signal is fed to the internal trigger switching logic circuit.

The internal trigger switching logic circuit controls the internal trigger switching circuit by switching with IC (U405) the control signal selected by the INT TRIG switch (S103) and the control signal received from the vertical switching logic circuit. This relationship is shown in the following table.

MODE / INT TRIG	CH1	ADD	CH2	TRIG VIEW / CH3
CH1	Triggered by CH1			
CH2	Triggered by CH2			
VERT MODE	Trig'd by CH1	Trig'd by CH1	Trig'd by CH2	Trig'd by CH1

*: The triggering functions of VERT MODE are effective only when in a single-channel display or in a multiple-channel display in the ALT mode. They remain idle when in the CHOP mode.

3.4 Delay Line Circuit

The vertical signal which has passed the diode gate circuit is amplified by the switching buffer circuit (Q403, Q404). The switching buffer circuit drives the delay line, with a matched output impedance.

The delay line is used to prevent the trigger point of the signal from being lost from being displayed on the screen due to time lag in the horizontal deflection circuits or the Z-axis amplifier circuits. For the delay line, this oscilloscope employs a delay cable which provides a delay time of approximately 100 nanoseconds. The vertical signal which has passed the delay line is fed to the vertical output amplifier.

3.5 Vertical Output Amplifier

The vertical output amplifier is comprised of a delay line receiver which receives the output signal of the delay line with a matched impedance, and a final amplifier which drives the vertical deflection plates of the CRT.

- Delay line receiver circuit:

The delay line receiver circuit (Q441, 442) is a low input impedance negative feedback amplifier which, with its input resistors R441 and R442, provides impedance matching with the characteristic impedance (Zo ≒ 186 ohms) of the delay line.

- Final amplifier:

The final amplifier boosts the signal to a level sufficient for driving the vertical deflection plates of the CRT. It is comprised of a pair of feedback-type SEPP amplifiers.

Transistors Q443, 445/Q444, 446 current-amplify the signal to a level sufficient for driving transistors Q447, 449/Q448, 450. The signal which has been voltage-amplified by transistors Q447, 449/Q448, 450 is returned to the input circuit through the negative feedback circuit (R454/R456). The gain in this case is as follows:

$$Av = \frac{R454}{R448} \qquad Av' = \frac{R456}{R449}$$

Transistors Q451/Q452 are for the dynamic bias circuit which controls the bias current with respect to the repetition frequency of the signal in order to economize current consumption.

3.6 Trigger Generator

The trigger generator is comprised of a trigger pulse generator circuit which produces a trigger pulse signal for driving the sweep generator and an AUTO circuit which produces a free-run signal for automatic sweep operation when the trigger signal is asynchronized or no trigger signal is applied.

The trigger pulse generator circuit of the trigger generator is comprised of a source switch which selects a trigger signal source, a coupling switch which selects a coupling mode in conformity with the nature of the trigger signal source, an impedance converter circuit which converts the high-impedance trigger source signal into a low-impedance signal with which to drive the level comparator circuit which controls the start point (triggered point) of the signal waveform displayed on the CRT screen, a TV synchronization separator circuit which picks off the synchronization signal from the TV video signal, and Schmitt trigger circuits which convert the output signals of the level comparator circuit and TV synchronization signal separator circuit into TTL level signals.

- Source switch:

The source switch (S501) selects the internal trigger signal fed from Q511, the line trigger signal fed from R526, the external trigger signal fed directly from J-72C, or the signal fed from J-72C through the 1/5 attenuator in order to be converted into the EXT ÷ 5 TRIG signal. The selected signal is fed to the coupling switch.

- Coupling switch:

The coupling switch (S502) selects the coupling mode: It selects the DC mode for direct coupling of the signal fed from S501, the AC mode for discarding the DC component, or the HF REJ mode for coupling via a low-pass filter. Switch S502 selects ON or OFF of the TV synchronization signal separator circuit which facilitates observation of a TV video signal.

o Impedance converter:

The impedance converter is a temperature-compensated-type source follower (Q514, 515) with pair FET's. It converts the trigger signal selected by the source switch and coupling switch into a low-impedance signal. The impedance is lowered further by the emitter follower of U501 and then the signal is fed to drive the level comparator circuit.

It also delivers the TRIG VIEW and CH3 signals from its U501 Pins Nos. 11 and 12.

o Level comparator:

The level comparator is a differential cascade amplifier (U501, Q516, Q517) which adjusts the rise up portion (or the fall down portion) of the comparator output signal by applying to U501 (Pin No. 14) of the current amplifier stage the trigger source signal from the impedance converter circuit and applying to U501 (Pin No. 9) the comparator level signal from the LEVEL control potentiometer (RV511-2). In this case, if switch S511 which is linked to the LEVEL control potentiometer is locked, the comparator level signal is applied to U501 (Pin No. 9) from the level lock circuit and the trigger point is fixed at the center of amplituded of the trigger source signal.

The level lock circuit amplifies with U503 the error signal detected by Q526 and Q527. The amplified signal is applied to U501 (Pin No. 9) so that the center level of the comparator output signal becomes equal to the Schmitt level of the Schmitt trigger circuit of a later stage.

Q516 and Q517 make up a current-to-voltage converter circuit which converts the current signal amplified by U501 back into a voltage signal. To its output circuit, a diode switch circuit which selects the slope of a signal for triggering is connected.

The output signal of the cascade amplifier is fed to the buffer amplifier which serves also as a TV synchronization signal separator circuit.

- Buffer amplifier/TV synchronization signal separator circuit:

  This circuit operates either as a buffer amplifier or as a TV synchronization signal separator circuit, being selected by the transistor switching circuit (Q518, Q520).

  When Q518 is on and Q520 is off, the circuit operates as a buffer amplifier and amplifies the output signal of the level comparator to a level sufficient for driving the Schmitt circuit of the next stage.

  When Q518 is off and Q520 is on, the circuit operates as a TV synchronization signal separator circuit and picks off the TV-H synchronization signal, which is pulsewidth-detected into a TV-V synchronization signal by the Schmitt circuit of the next stage.

- TRIG Schmitt circuit:

  The TRIG Schmitt circuit is a conventional one which generates a hysteresis voltage by applying a feedback signal with R577 to the two stages of NAND gates of U502. The output of the Schmitt circuit is fed to an inverter. One output of the inverter drives the AUTO circuit and another output of the inverter drives the A and B SWEEP generators.

- AUTO circuit:

  The AUTO circuit is comprised of a uni-junction transistor (UJT) circuitry made up by connecting mutually the bases and collectors of a PNP transistor (Q523) and an NPN transistor (Q524). This circuit converts the high-speed pulse output signal of the Schmitt circuit into a DC signal, which is conditioned for waveform-shaping by the gate circuit (Q525) to drive the A sweep generator and the TRIG'D LED lamp.

3.7 A and B Sweep Generators

The A sweep generator produces the sawtooth signal for the main sweep (A sweep) of this oscilloscope. The B sweep generator produces the sawtooth signal for magnification in the time axis direction the waveform displayed on the main sweep or for display with a certain time delay (delayed sweep or B sweep).

The A sweep generator consists of the A sweep gate circuit which receives the trigger signal from the trigger generator and produces the sweep gate signal for starting sweeps, the sweep start comparator which maintains stably the sweep start point, the A sawtooth sweep generator which produces a sawtooth wave in conformity with the time constant selected by the TIME/DIV switch, the sweep length circuit which controls the length of sweeps, the hold off circuit which controls the sweep return period and pause period, and the A sweep gate enable circuit which controls the sweep gate circuit in conformity with the AUTO, NORM or SINGLE mode as selected by the MODE switch for the signals of the above control circuits.

o A sweep gate:

The A sweep gate circuit employs a flip-flop TTL IC (U602-1/2) with preset/clear function. The trigger pulse of the trigger generator is applied to the CLOCK (Pin No. 11) terminal, the enable signal of the A sweep gate enable circuit to the CLEAR (Pin No. 13) terminal, and the enable signal and AUTO signal of the AUTO circuit to the PRESET (Pin No. 10) terminal through the NOR gate circuit. The $\overline{Q}$ (Pin No. 8) terminal output is applied as the unblanking signal to the Z-axis amplifier, and fed to the sweep start comparator circuit and becomes the A sweep gate signal. Even when no trigger pulse signal is applied to the CLOCK terminal, the $\overline{Q}$ output can be made the low state with the AOTO signal of the PRESET terminal so that the A sweep gate signal is generated and the circuit operates in the free-run mode.

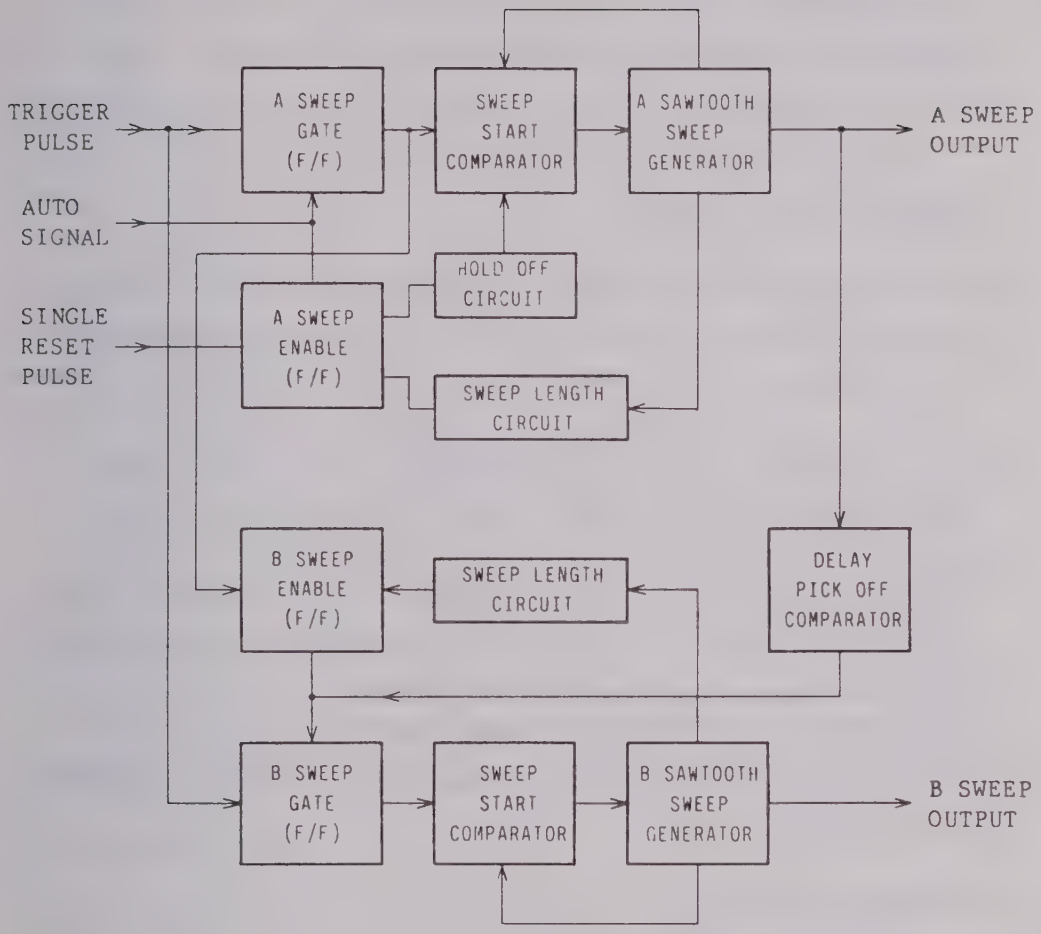

TRIGGER PULSE
AUTO SIGNAL
SINGLE RESET PULSE
A SWEEP GATE (F/F)
SWEEP START COMPARATOR
A SAWTOOTH SWEEP GENERATOR
A SWEEP OUTPUT
HOLD OFF CIRCUIT
A SWEEP ENABLE (F/F)
SWEEP LENGTH CIRCUIT
B SWEEP ENABLE (F/F)
SWEEP LENGTH CIRCUIT
DELAY PICK OFF COMPARATOR
B SWEEP GATE (F/F)
SWEEP START COMPARATOR
B SAWTOOTH SWEEP GENERATOR
B SWEEP OUTPUT

Figure 3-4

o Sweep start comparator:

The sweep start comparator (Q615, 616) is a differential amplifier which lets the sweep gate signal pass and maintains constant the sweep start level. A start reference level identical with the B sweep start level is applied to one of the inputs, the Miller integrator output signal is applied to the other input, and the difference between the two signals is compensated for.

o A sawtooth sweep generator:

The A sawtooth sweep generator is comprised of a gate transistor amplifier, a Miller integrator, an integration time constant switching circuit, and a TIME/DIV switch which controls the switching circuit. The gate transistor amplifier (Q618) controls the Miller integrator circuit in such manner that the start level control signal and sweep gate signal of the sweep start comparator do not affect the integration time constant. The Miller integrator (Q621, 622) produces a sawtooth signal with the time constant selected by the integration time constant selector circuit. The integration time constant selector circuit selects integration capacitor C620/C622 with Q620. For integration current, resistor array R694 is directly selected by the TIME/DIV switch (S602-2).

o Sweep length circuit:

The sweep length circuit divides with resistors R620 and R644, and shapes the waveform with Q611 to obtain a sweep length signal.

o Holdoff circuit:

The holdoff circuit generates a holdoff (pause) time signal proportional to the sweep time by producing a triangular wave with an integrator circuit and making use of the rise time of the triangular wave. The integrator, with its Q613, selects the time constant in accordance with the integration output voltage in order to cover a wide time range. The output signal of the integrator circuit is shaped by Q612 into a holdoff signal.

o A sweep gate enable circuit:

The A sweep gate enable circuit employs the flip-flop IC (U602-2/2) which makes up a pair with the A sweep gate circuit. The holdoff signal is applied to the PRESET (Pin No. 4) terminal, the length signal is applied to the CLEAR (Pin No. 1) terminal, and the enable signal is delivered from the Q (Pin No. 5) terminal. This enable signal presets or clears the A sweep gate circuit. When in the NORM sweep mode, the output signal of the AUTO circuit is blocked and, if no trigger signal is applied, the circuit is in the ready state. When in the SINGLE sweep mode, the holdoff circuit remains idle and a one-shot sweep is effected by the reset signal applied from the CLOCK (Pin No. 3) terminal.

The basic structure of the B sweep generator is identical with that of the A sweep generator. It consists of the B sweep gate circuit, sweep start comparator, B sawtooth sweep generator, sweep length circuit, B sweep enable circuit, and delay pickoff comparator. The B sweep generator requires no holdoff circuit because it operates only during the period the A sweep generator is in the sweep operation. Instead of the holdoff signal, the A sweep gate signal sets the B sweep enable circuit to the enable state.

o Delay pickoff comparator:

The delay pickoff comparator (Q632 - 634) employs a dual FET (Q634) to obtain a certain time relationship as set by the delay time multiplication potentiometer (RV613) with respect to the A sweep signal. The comparator compares the A sweep output signal (sawtooth waveform) with the voltage set by RV613, generates a delayed sweep start signal, and sets the B sweep gate circuit to start the B sweep signal. When in the B TRIG'D mode, the B sweep gate circuit is not set directly with this delayed sweep start signal but the PRESET (Pin No. 4) terminal is set to the high state and the B sweep signal is started as driven by the trigger pulse of the trigger generator.

3.8 Horizontal Switching Circuit

The horizontal switching circuit is comprised of a switching buffer circuit which prevents switching distortion from being sent to the sweep circuit of the preceding stage, a display switching circuit which electronically switches the A and B sweep signals and CH1 HOR (X) signal, and a display logic circuit to control these circuits.

- Switching buffer circuit:

The switching buffer circuit is of a grounded-base-type amplifier. Transistor Q624 is for buffer-amplification of the A sweep signal, transistor Q649 for the B sweep signal.

- Display switching circuit:

The display switching circuit, with its analog signal multiplexer IC (U702), selects the A and B sweep signals and CH1 HOR (X) signal.

- Display switching logic circuit:

The display switching logic circuit, with its flip-flop IC (U701-1/2) which has a preset/clear terminal, controls the display switching circuit in conformity with the operation mode selected by the HOR DISPLAY switch (S701). With its another flip-flop IC (U701-2/2), it generates the alternate switching pulse signal for the vertical axis circuits.

3.9 Horizontal Output Amplifier

The horizontal output amplifier consists of a drive amplifier which selects between NORM and ×10 MAG mode for the horizontal signal received from the horizontal switching circuit and drives the output amplifier, and an output amplifier which drives the horizontal deflection plates of the CRT.

o Drive amplifier:

The drive amplifier (Q703 - 706) converts the horizontal signal received from the horizontal switching circuit into a differential signal, with which to drive the output amplifier. With Q703 and 704, gain of the differential amplifier can be multiplied by a factor of 10 for the ×10 MAG function.

o Output amplifier:

The output amplifier (Q707 - 716) is comprised of feedback-type SEPP amplifiers symmetrical for right and left which provide sufficient speed and output voltage for driving the horizontal deflection plates of the CRT. The signal current-amplified by Q707/Q708 is converted into a voltage signal by Q709 - Q716 to obtain a sufficiently high gain and a sufficiently low output impedance. By means of negative feedback resistor R735/R736 a stable gain and wide and flat frequency response are attained.

3.10 Z-axis Amplifier

The Z-axis amplifier is comprised of an input circuit and an output amplifier. The input circuit merges the unblanking signals of the A and B sweep generators, the external intensity modulation signal applied through the Z-axis input terminal, the B intensity control signal, and the overall intensity control signal. The output amplifier amplifies the merged signal into a sufficient level for driving the G1 grid of CRT.

o Input circuit:

The input circuit merges the unblanking signals of the A and B sweep generators, the chopped blanking signal, the external intensity modulation signal applied via the X-axis input terminal, and the overall intensity control signal. The resultant compound signal is fed to the output amplifier.

o Output amplifier:

The output amplifier amplifies the above compound signal to several tens volts. It is of a feedback-type SRPP circuit (Q833, 837, 838). This amplifier also generates (with its Q834, 835, 836) a linear focus signal which is in the inverted phase of the unblanking signal. The amplified unblanking output signal and linear focus signal are fed to the G1 and P1 of the cathode-ray tube through the CRT control citcuit to drive the intensity and focus of the displayed waveform.

3.11 CRT Control Circuit

The CRT control circuit is comprised of a DC regeneration circuit which converts the linear focus signal and the unblanking output signal of the Z-axis amplifier into the operating-voltage signals of the CRT in order to be applied to the focus electrode and G1 electrode of the CRT, semi-fixed potentiometers ASTIG (RV881), GEOMETRY and SUB-FOCUS (RV831), a trace rotation circuit for adjusting the trace direction in parallel with the horizontal graticule lines, and an illumination circuit for illuminating the graticule.

o DC regeneration circuit:

The DC regeneration circuit converts the linear focus signal and unblanking signal of several tens to several hundreds volts into AC signals with the switching signal of the DC-DC converter circuit, and then converts them back into DC signals with respects to the cathode voltage and focus reference voltage of the sub-focus potentiometer in order to provide a focus signal and an unblanking signal of the operating voltages of the CRT.

3.12 HV Regulator (High Voltage Generator)

The high voltage generator produces an acceleration voltage (-1750 V) applied to the CRT cathode and a post-acceleration voltage (approximately +16 kV) applied to the CRT anode to accelerate the electrons beam which have passed the X and Y deflection plates and mesh electrode. The circuitry is a

DC-DC converter with blocking oscillator (Q831), with resonance of the secondary coil winding. The high voltage of approximately 3600 Vp-p (frequency approximately 30 kHz) generated by the blocking oscillator is 9-times voltage-multiplication rectified by a Cockcroft circuit into a positive voltage of approximately 16 kV and it is half-wave rectified into a negative voltage of -1750 V.

This DC-DC converter feeds the negative voltage of approximately 1750 V via a high resistance circuit (R841, R842) to the control circuit (U831) to obtain a stabilized voltage. It also is fed through a capacitor—coupling circuit to the DC regeneration circuit in order to be used as the switching signal.

3.13 Power Supply Circuit

The power supply circuit steps up or down with its power transformer the AC line voltage into various voltages and rectifies them to DC supply voltages for the various circuits of the oscilloscope. The primary winding of the power transformer is of a split type, in order that the oscilloscope can be operated on various AC line voltages by connecting the transformer taps in series or parallel as required by means of the line voltage selector plug (P-47). Regarding the secondary circuit, the transformer has one 6 V winding for the CRT heater and two windings of different voltages for different circuits of the CRT. The AC voltages of the two windings are rectifies and supplied as non-regulated +16.5 V power and regulated + 140 V, +12 V, +5 V, and -12 V powers.

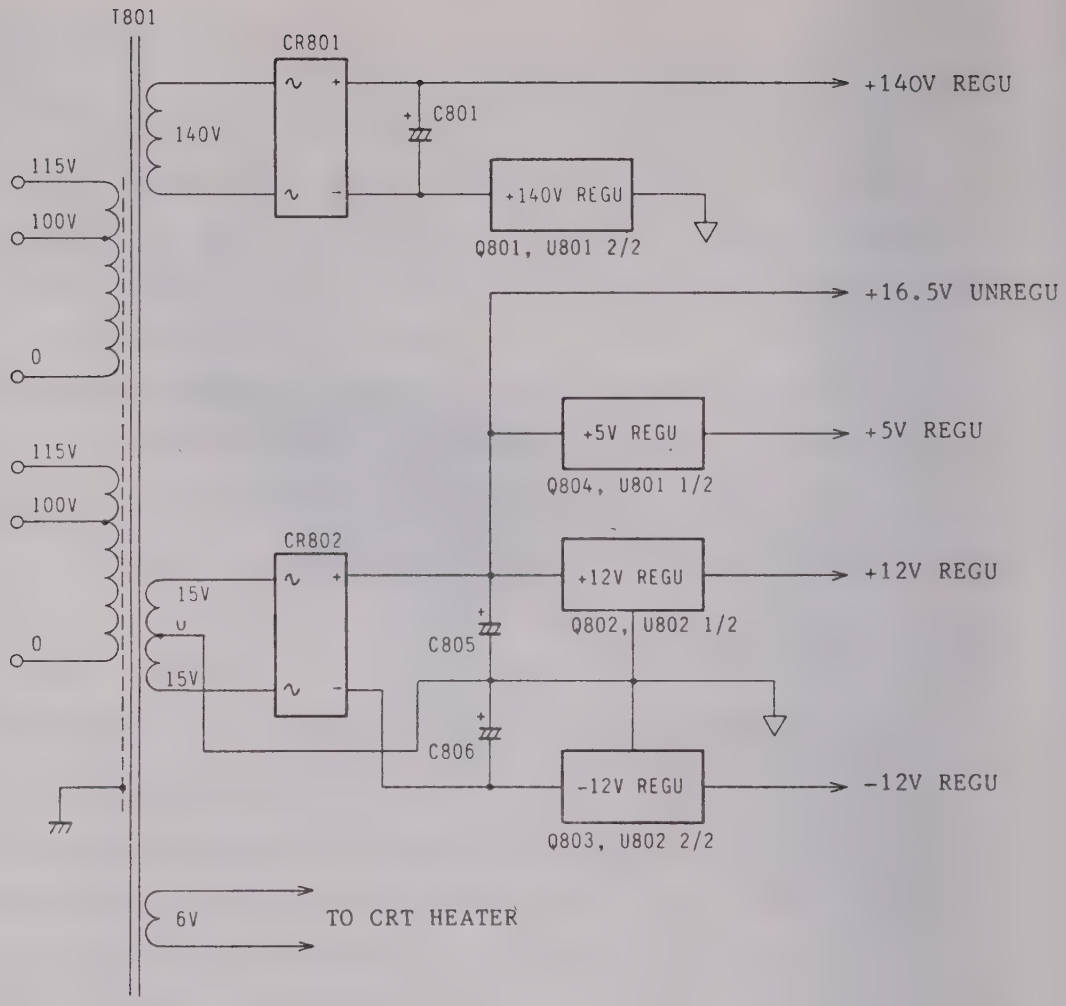


Figure 3-5

3.14 Calibrator Circuit

The calibrator circuit provides square-wave calibration voltage signal of 2 Vp-p which is used for calibration of the probe and the amplifiers when they are operated in the non-calibrated mode. The voltage accuracy of the calibration signals is 2% or better. The calibration signal is produced by generating a signal with the multivibrator of CMOS IC (U1601 1/4, 2/4), shaping the waveform with the Schmitt circuit of CMOS IC (U1601 3/4, 4/4), and dividing the voltage signal with resistors.

4. CALIBRATION

4.1 General

After the oscilloscope has been used for a period of time, it should be calibrated. Although calibration of overall performances is recommended, partial calibration may serve the purpose as that the time axis alone is calibrated when the time measuring accuracy is especially important or that the vertical axis alone is calibrated when the vertical sensitivity accuracy is of prime importance. After the oscilloscope has been repaired, overall calibration is suggested although it depends on the type of repair. For accurate calibration service, contact your Kikusui agent.

4.2 Removing the Case

To remove the case, remove the four screws (Figure 4-1) and pull out the chassis forward.

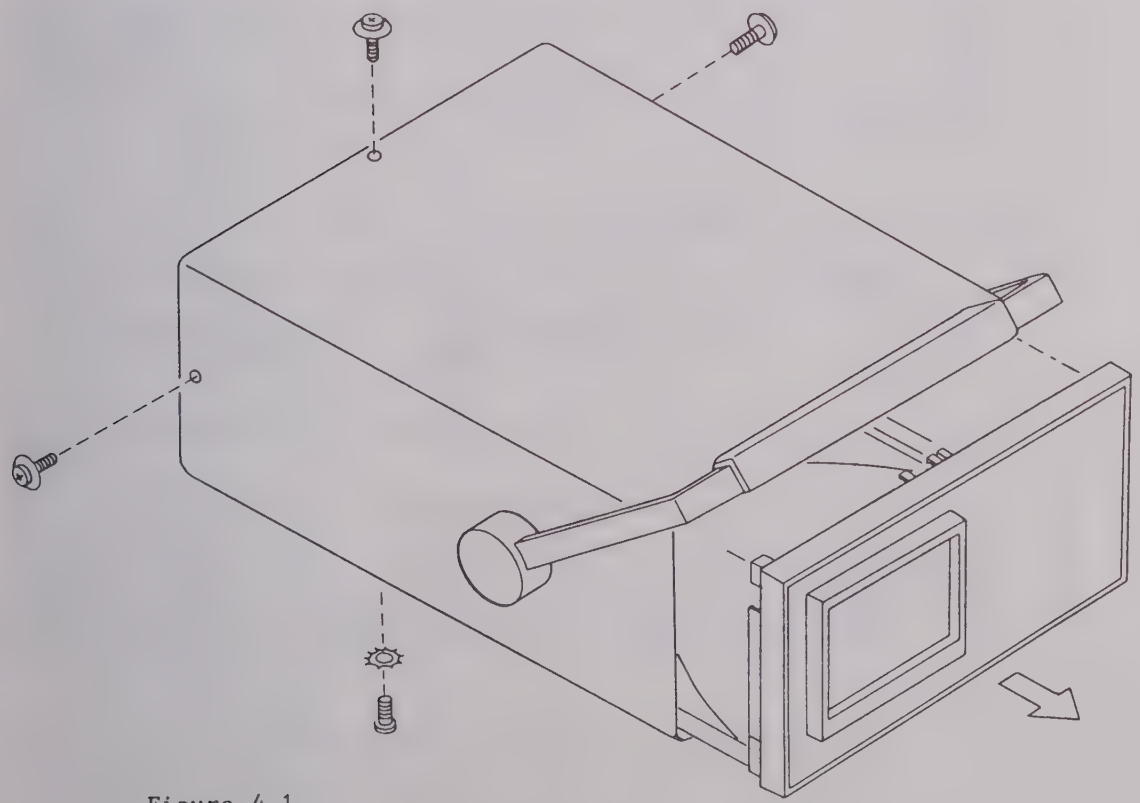


Figure 4-1

4.3 Check and Adjustment of DC Supply Voltages

Before calibrating the oscilloscope, its DC supply voltages should be checked and adjusted. Check and adjust the +12V supply voltage first and the other supply voltages next. The supply voltages are shown in the following table and the check and adjustment points are indicated in Figure 4-2.

Nominal voltage	Tolerance	Check and adjustment points
+5 V	+4.75 to +5.25 V	P-24 No. 7
+12 V	+11.95 to +12.05 V	P-24 No. 8, RV801
-12 V	-11.80 to -12.20 V	P-24 No. 9
+140 V	+135 to +145 V	P-24 No. 5
-1750 V	-1700 to -1750 V	

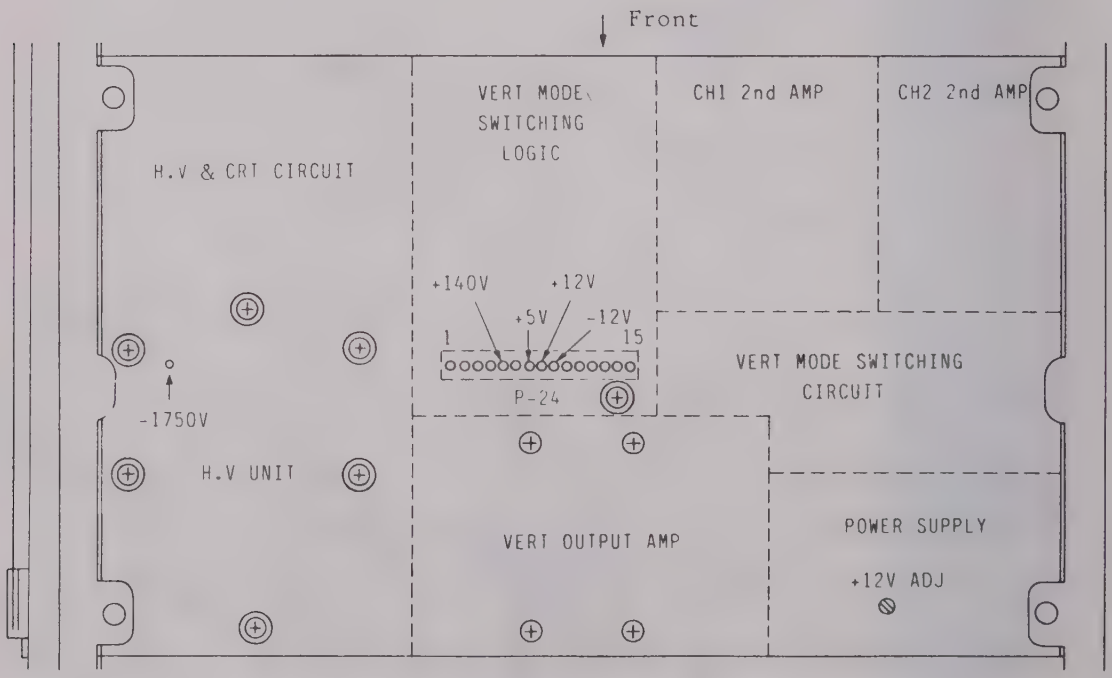


Figure 4-2 A2 printed circuit board

For voltage check, measure the voltage between check point and ground using precision digital voltmeter. The +12V supply must be especially carefully adjusted because it provides a reference for other supplies. To measure the -1750V supply of which internal impedance is high, use a voltmeter which has a sufficiently high input impedance (10 MΩ or over).

Because adjustments of supply voltages largely affect vertical sensitivity and horizontal sweep time, the oscilloscope must be re-calibrated as explained in the subsequent paragraphs.

4.4 Adjustment of CRT Circuits

Some adjustments of the CRT circuits directly affect the CRT deflection sensitivity as is the case of "Check and Adjustment of DC Supply Voltages" of the preceding section.

- o Adjustment of CRT BIAS:

This control is for adjusting the trace intensity and the operating position of the INTEN knob (2).

(1) Set the TIME/DIV switch (31) at 1 mS and display a single-line horizontal trace on the screen.

(2) Set the white mark of the INTEN knob at the 10 o'clock position and so adjust the CRT BIAS control (Figure 4-7, RV821) that the trace is displayed on the screen with a barely discernible intensity.

- o Adjustment of SUB-FOCUS:

This control is for adjusting the control range position of the FOCUS knob (4). With the FOCUS knob set with its white dot positioned upright (noon position), so adjust the SUB-FOCUS control (Figure 4-7, RV820) that the best focus is obtained.

o Adjustment of ASTIG:

This control is for focus adjustment of the electron lens of the CRT.

(1) Set the TIME/DIV switch (31) to the [X-Y | CH3 HOR] position and display the beam spot in the center of the CRT screen with the POSITION controls.

(2) Turn the FOCUS control (4) to an appropriate position and then adjust the ASTIG control (Figure 4-7, RV822) so that the shape of the displayed beam spot becomes as true circle as possible.

4.5 Adjustment of Vertical Axis

o Adjustment of STEP BAL:

This control is for minimizing the shift of trace when the VOLTS/DIV switch (10) or (13) is turned from the 5 mV position to the 10 mV position.

(1) Set the AC-GND-DC switch (7) or (16) and display the trace on the CRT screen.

(2) Turning the VOLTS/DIV switch between 5 mV and 10 mV positions, so adjust the STEP BAL control (Figure 4-8, RV101 or RV201) that the shift of trace becomes minimum.

o Adjustment of ×5 MAG BAL:

This control is for minimizing the shift of trace when the ×5 MAG switch (11) or (14) is changed.

(1) Set the AC-GND-DC switch (7) or (16) in the GND state and display a trace on the screen.

(2) Turning on and off the ×5 MAG switch, so adjust the ×5 MAG BAL control (Figure 4-8, RV102 or RV202) that the shift of trace becomes minimum.

o Adjustment of DC BAL:

This control is for minimizing the shift of the trace when the VARIABLE KNOB (11) or (14) is turned.

(1) Set the AC-GND-DC switch (7) or (16) in the GND state and display the trace on the CRT screen.

(2) Turning the VARIABLE knob, so adjust the DC BAL control that the shift of the trace becomes minimum. (Figure 4-8, RV103 and RV203).

o Sensitivity calibration of CH1 and CH2:

Calibrate the sensitivity of the vertical amplifier to the value indicated by the VOLTS/DIV switch (10) or (13). For this adjustment, use a square wave generator with an output voltage setting accuracy of 0.3% or better, at 1 kHz.

(1) Set the signal generator output at 50 mVp-p and apply the signal to the vertical input terminal (8) or (15).

(2) Set the VARIABLE knob (11) or (14) at the CAL'D position and set the VOLTS/DIV switch at the 10 mV range.

(3) So adjust the CH1 or CH2 GAIN control (Figure 4-7, RV114 or RV214) that the amplitude of the displayed waveform becomes 5 DIV.

By the above procedure, other ranges also are calibrated to an accuracy of ±3% or better.

o Sensitivity calibration of ×5 MAG:

In a similar manner as for sensitivity calibration of CH1 and CH2, calibrate the sensitivity for the ×5 MAG function.

(1) Set the signal generator output at 10 mVp-p and apply the signal to the vertical input terminals (8) and (15).

(2) Set the VARIABLE knob (11) or (14) to the CAL'D position, set the VOLTS/DIV switch (10) or (13) to the 10 mV range, and pull out the CH1 ×5MAG switch (11) or (14).

(3) Adjust the CH1 or CH2 GAIN control (Figure 4-8, RV104 or RV204) so that the amplitude of the displayed waveform becomes 5 DIV.

By the above procedure, other ranges also are calibrated to an accuracy of ±5% or better.

o Sensitivity calibration of CH3:

In a similar manner as for sensitivity calibration of CH1 and CH2, calibrate the sensitivity of the CH3 vertical amplifier.

(1) Set the signal generator output to 500 mVp-p and apply the signal to CH3 input terminal (20). Next, set the source selector switch (23) to the CH3 (EXT) position and display the waveform.

(2) Adjust the CH3 GAIN control (Figure 4-9, RV512) so that the amplitude of the displayed waveform becomes 5 DIV.

o Adjustment of ADD BAL:

With both CH1 and CH2 channels operating in a single-line horizontal trace state at the center of the screen, adjust this control so that the traces do not shift even when the VERT MODE switch is changed to the ADD mode.

(1) Set the AC-GND-DC switches (7) and (16) in the GND state and display the traces of the two channels overlapped at the center of the CRT.

(2) Change the VERT MODE switch to the ADD state and adjust the ADD BAL control (Figure 4-7, RV401) so that the traces are positioned at the center of the CRT.

o Adjustment of CH2 INV CENTER:

Display the CH2 trace at the center of the CRT. Adjust this control so that the displayed trace is not shifted even when the POSITION knob is pulled out to the CH2 INV state.

1) Set the AC-GND-DC switch (16) to the GND state and display the CH2 trace at the center of the CRT.

2) Pull out the CH2 POSITION knob (17) to the CH2 INV state and adjust the INV CENTER control (RV443 in Figure 4-7) so that the trace is positioned at the center of the CRT.

o Adjustment of square wave characteristics of vertical amplifiers:

This adjustment is to adjust the square wave characteristics of the vertical amplifiers and to make their frequency response flat. This adjustment should be done at a range which does not use the input attenuator (10 mV/DIV range), using a square wave of 100 kHz and that of 1 MHz.

Adjustment should be done using a quality square wave with a rise time of 1.0 nsec or faster, in the order of middle and high ranges, repeating adjustment for a few times.

(1) Adjustment for middle frequency range:

Set the VOLTS/DIV switch at 10 mV/DIV and the TIME/DIV switch at 20 μS/DIV. Apply to the vertical input terminal a square wave of 100 kHz and so adjust the signal generator output that the waveform is displayed with an amplitude of 6 DIV.

Next, so adjust RV441, C445 (Figure 4-7) that the displayed waveform becomes as (b) in Figure 4-3.

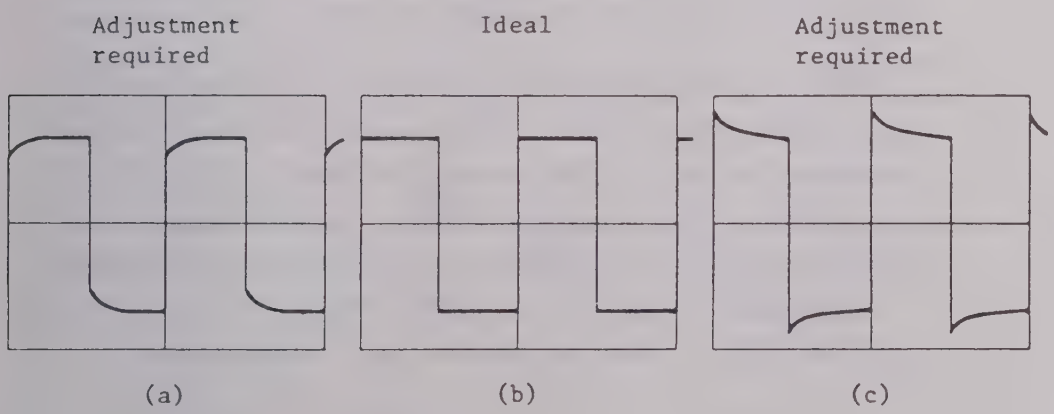


Figure 4-3

(2) Adjustment for high frequency range:

Change the input pulse signal frequency to 1 MHz and set the TIME/DIV switch at 0.2 μS/DIV. Next, so adjust RV442 and C446 (Figure 4-7) that a waveform as shown in (b) of Figure 4-4 is obtained.

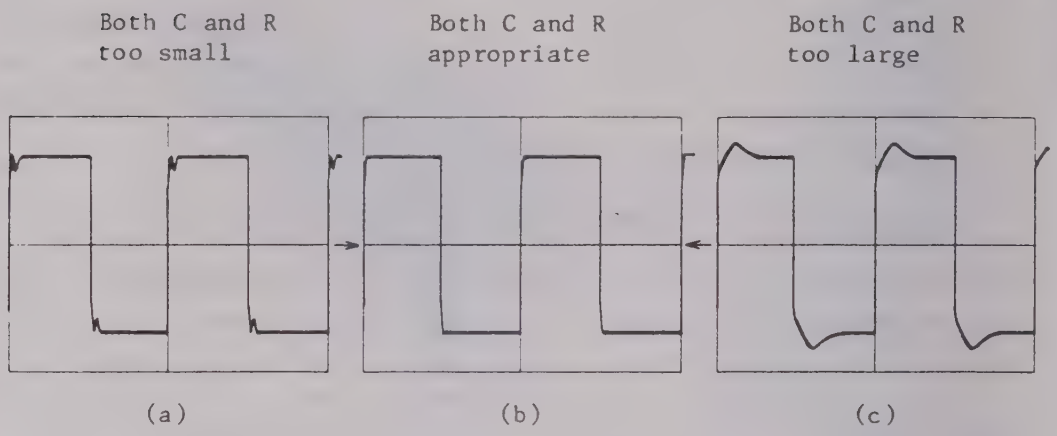


Figure 4-4

(3) Adjustment for highest frequency range:

This adjustment is to make still more sharp the leading edge and reduce ringing at the leading edge of the pulse waveform which has been adjusted in step (2).

For this adjustment, adjust at first CH1 and CH2 to the same characteristics and adjust CH3 next.

Change the TIME/DIV switch to the 20 nS/DIV position and expand the front edge of the pulse waveform which has been adjusted in step (2) "Adjustment for high frequency range." First, adjust RV113 and C168 (RV213 and C268 in the case of CH2) so that the front edge of the displayed waveform becomes flat. Next, adjust C138 of Figure 4-8 (C238 in the case of CH2) so that the leading edge becomes sharp.

Repeat the above adjustment so that flat square wave characteristics with sharp leading edge is obtained and the difference between CH1 and CH2 becomes minimum.

Next, change the channel to CH3 and adjust the HF COMPEN control (C535 of Figure 4-9).

After the above adjustment is done, check again that the frequency response characteristics of all channels are satisfactory.

o Adjustment of input ATT of CH1 and CH2:

The VOLTS/DIV switch selects the oscilloscope sensitivity by switching the attenuator circuit consisting of the 1st attenuator (1/1, 1/10, 1/100 steps) and the 2nd attenuator (1/1, 1/2, 1/4, 1/10 steps). This procedure is for phase compensation and input capacitance adjustment of the attenuators. Adjustments should be done in the order of phase compensation and input capacitance adjustment.

Use a square wave signal generator which provides a quality square wave of rise time 1 μsec or faster, without sags or overshoots. Apply the signal for each of the ranges (0.1 V, 1 V) and display a waveform with an amplitude of 6 DIV. So adjust the phase compensation capacitors shown in the following table (see Figure 4-4) that an ideal waveform is displayed. Next, connect a low-capacitance C-meter to the input terminal and so adjust the input-capacitance compensation capacitor that the input capacitance at each range becomes 25 pF ±2 pF.

Compensation capacitor / Range	CH1		CH2	
	Phase compensation	Input capacitor	Phase compensation	Input capacitor
0.1 V (1/10)	C104	C103	C204	C203
1 V (1/100)	C107	C106	C207	C206

o Adjustment of input ATT of CH3:

In a similar manner as is the case of "Adjustment of input ATT of CH1 and CH2," check that the 1/1 input capacitance is 25 pF ±2 pF. Next, adjust phase of the 1/5 attenuator with C525 (Figure 4-9) and input capacitance with C524.

o Adjustment of CH1 SIGNAL OUTPUT DC OFFSET:

* This adjustment must be made after "Adjustment of CH1 TRIG OFFSET" of Section 4.6 has been done.

This adjustment is to make zero the DC offset of the CH1 signal output with the DC OFFSET control.

(1) Apply the CH1 signal output to the CH2 input terminal using a coaxial cable.

(2) Display the CH2 input signal on the screen and set the VOLTS/DIV switch at the 10 mV range.

(3) Changing the CH2 input coupling switch between GND and DC, so adjust the CH1 SIGNAL OUTPUT DC OFFSET control RV112 (Figure 4-7) that shift of the trace becomes zero.

4.6 Adjustment of Trigger Circuit

o Adjustment of CH1 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH1 internal trigger output.

(1) Apply a sinusoidal signal of approximately 1 kHz to the CH1 input terminal and set the AC-GND-DC switch at AC.

(2) Set the VERT MODE switch at CH1, set the INT TRIG switch at CH1 or ALT, and display the signal with an amplitude of 8 DIV on the screen.

(3) Set the COUPLING switch at AC and so adjust the LEVEL knob that the trigger point is brought to the center of the displayed waveform amplitude.

(4) Change the COUPLING switch to DC and so adjust the CH1 TRIG DC OFFSET (Figure 4-7, RV110) that the trigger point is brought to the center of the displayed waveform amplitude.

o Adjustment of CH2 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH2 internal trigger output.

For this adjustment, adjust CH2 TRIG DC OFFSET (Figure 4-7, RV210) in a similar manner as is the case of "Adjustment of CH1 TRIG DC OFFSET."

4.7 Adjustment of Time Base

o Calibration of A sweep time:

This adjustment is for calibrating the sweep time to the values indicated by the TIME/DIV switch (31). For this adjustment, use time marker signals of accurate time intervals of 1 msec and 1 μsec or use signals of accurate frequencies of 1 kHz and 1 MHz.

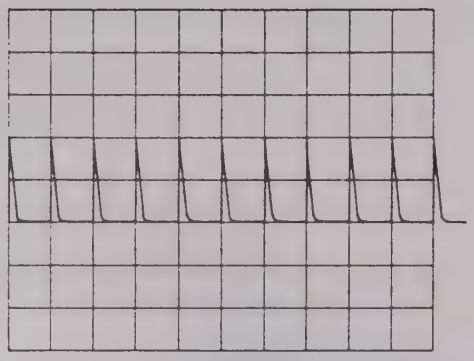
(1) Apply to the vertical input terminal a time marker signal of 1 msec or sinusoidal wave signal of 1 kHz and set the TIME/DIV switch (31) at 1 mS.

(2) So adjust the 1 mS CAL (Figure 4-9, RV614) that the displayed signal waveform conforms with scale divisions of the graticule.

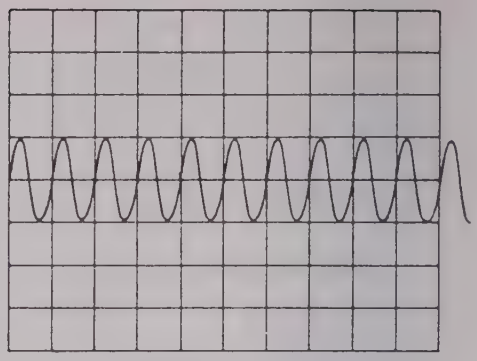
(3) Next, change the input signal to a 1-μsec time marker signal or a 1-MHz repetitive frequency signal and change the TIME/DIV switch (31) indication to 1 μS.

(4) So adjust C621 (Figure 4-9) that the displayed signal waveform conform with scale divisions of the graticule.

When the above calibration is complete, the sweep speeds of the remaining ranges of the TIME/DIV switch (31) also are calibrated to an accuracy of ±3% or better.



Time marker signal



Sinusoidal wave signal

Figure 4-5

o Calibration of B sweep time:

Calibrate the sweep time to the indicated values of the TIME/DIV switch (32). Adjust 1mS (Figure 4-9, RV615) and C645 (Figure 4-9) in a similar manner as that for the case of "Calibration of A sweep time."

o Adjustment of sweep start points:

This adjustment is for aligning the start points of the A and B sweeps.

(1) Set the TIME/DIV switches (31) and (32) at 1 mS, set the DISPLAY switch (30) at ALT, and display both A and B traces on the screen.

(2) So adjust the horizontal POSITION knob (36) that the start point of the A trace is brought to the left hand end of the graticule.

(3) Next, with the B SWEEP START POSITION control (Figure 4-9, RV616), bring the start point of the B trace to the left hand end of the graticule.

o Calibration of DELAY TIME MULT:

This calibration is for calibrating the dial value of the DELAY TIME MULT to the sweep time. Before performing this calibration, make sure that the adjustment for "Calibration for A sweep time" has been done.

(1) Apply to the vertical input terminal a time marker signal of 1 mS and display the waveform with an appropriate amplitude on the screen.

(2) Set the VARIABLE knob (33) at the CAL'D position, set the TIME/DIV switch (31) at 1 mS, set the TIME/DIV switch (32) at 10 μS, and change the DISPLAY switch (30) to the ALT state.

(3) Set the dial indication of the DELAY TIME MULT at 1.00 and align the displayed waveform with the graticule.

(4) So adjust the DT START (Figure 4-9, RV611) that the accentuated portion of the waveform is aligned to the initial pulse as shown in Figure 4-6.

(5) Set the dial indication of the DELAY TIME MULT at 10.00.

(6) So adjust the DT END (Figure 4-9, RV612) that the accentuated portion of the waveform is aligned to the 10th pulse.

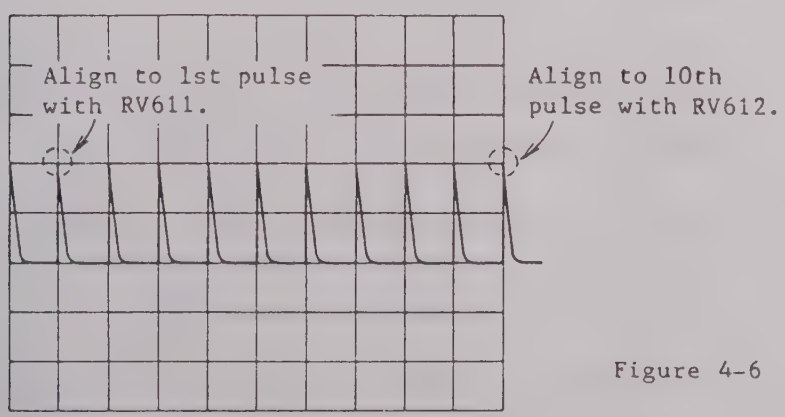


Figure 4-6

4.8 Adjustment of Horizontal Axis (X-axis)

o Calibration of horizontal sensitivity:

This adjustment is for calibration of the X-axis or CH3 HOR sensitivity for X-Y operation.

(1) Set at 1 Vp-p the output of the signal generator used for "Calibration of sensitivity" of Section 4.5, and apply the output to the CH3 input terminal.

(2) Set the TIME/DIV switch (31) at [X-Y | CH3 HOR], the SOURCE switch (23) at CH3, and the COUPLING switch (24) at DC.

(3) So adjust the CH3 HOR GAIN control (Figure 4-9, RV601) that the horizontal length of the trace becomes 10 DIV.

(4) Repeat the procedures of "Adjustment of CH1 SIGNAL OUTPUT DC OFFSET" of Section 4.5 and "Adjustment of CH1 TRIG DC OFFSET" of Section 4.6.

(5) Set the SOURCE switch (23) to the INT ([X-Y]) and the INT TRIG switch (18) to the [X-Y]. Set the signal generator output at 100 mV and apply it to the CH1 (X) input terminal.

(6) So adjust the X-GAIN control (Figure 4-7, RV111) that the horizontal length of the trace becomes 10 DIV.

o Adjustment of X-Y POSITION ADJ:

This adjustment is for adjusting the positional relationship for the ↔ POSITION control when operation is switched between the NORM sweep mode and the [X-Y | CH3 HOR] mode.

(1) Set the TIME/DIV switch (31) at 1 mS/DIV. Align the start point of the sweep with the left hand end of the CRT graticule with the ↔ POSITION control (36).

(2) Change the TIME/DIV switch (31) to the [X-Y | CH3 HOR] to select the X-Y mode.

(3) So adjust the X-Y POSITION ADJ control (Figure 4-9, RV602) that the beam spot is positioned at the center of the CRT graticule.

4.9 Adjustment of Calibration Signal

o Adjustment of repetition frequency:

This adjustment is for calibrating the repetition frequency of the calibration signal at 1 kHz.

(1) Connect the CAL output (40) to a frequency counter.

(2) So adjust the CAL ADJ (Figure 4-8, RV1606) that the frequency counter indicates 1 kHz.

LOWER PRINTED CIRCUIT BOARDS

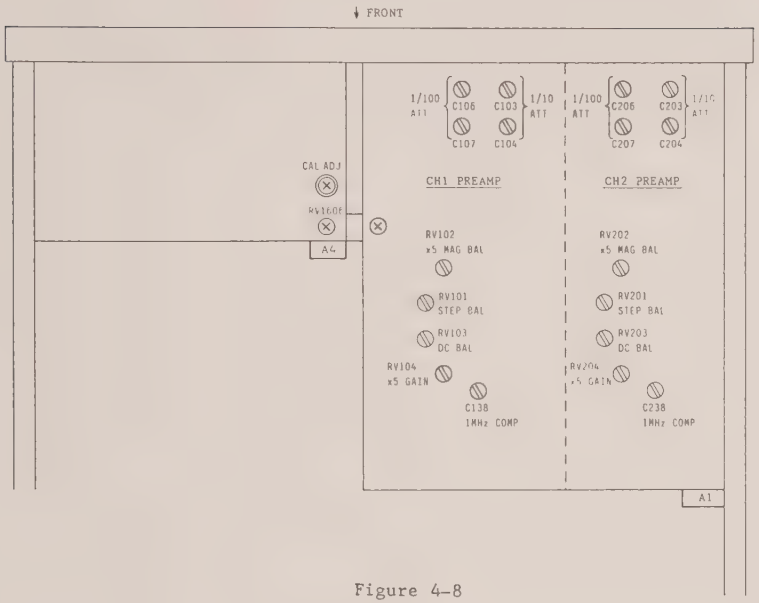


Figure 4-8

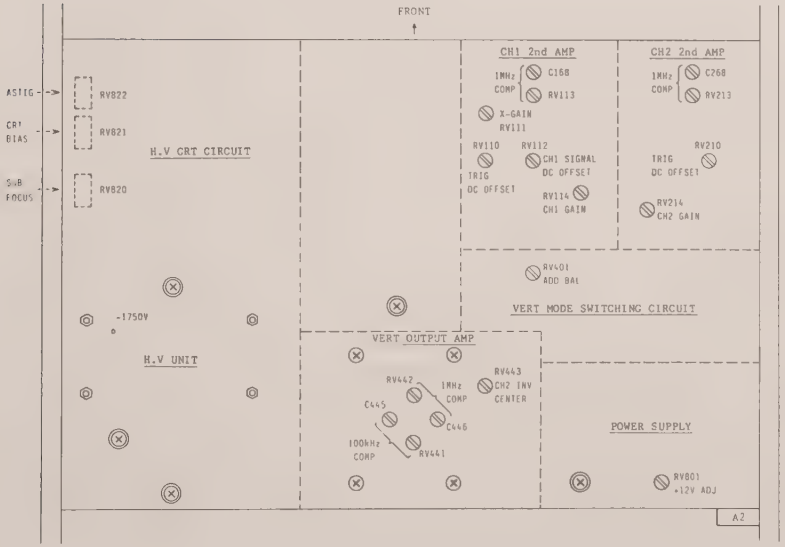
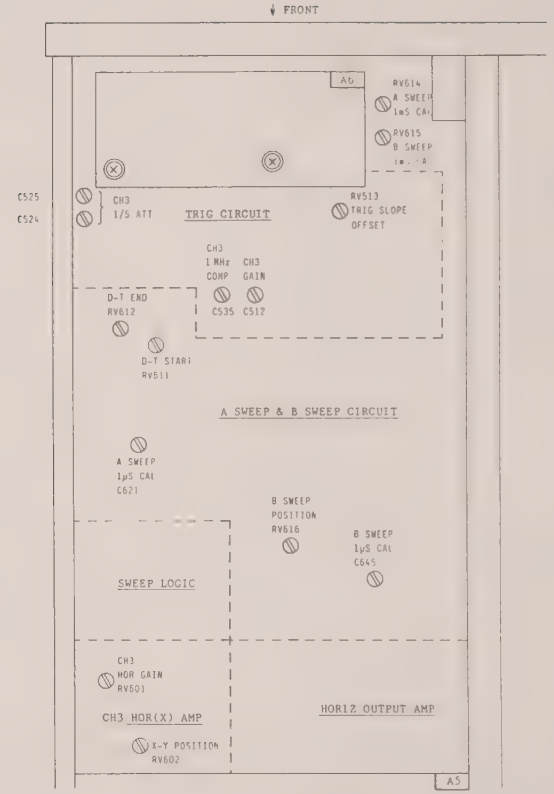
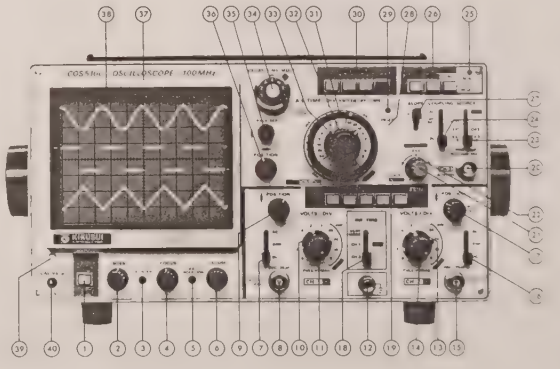


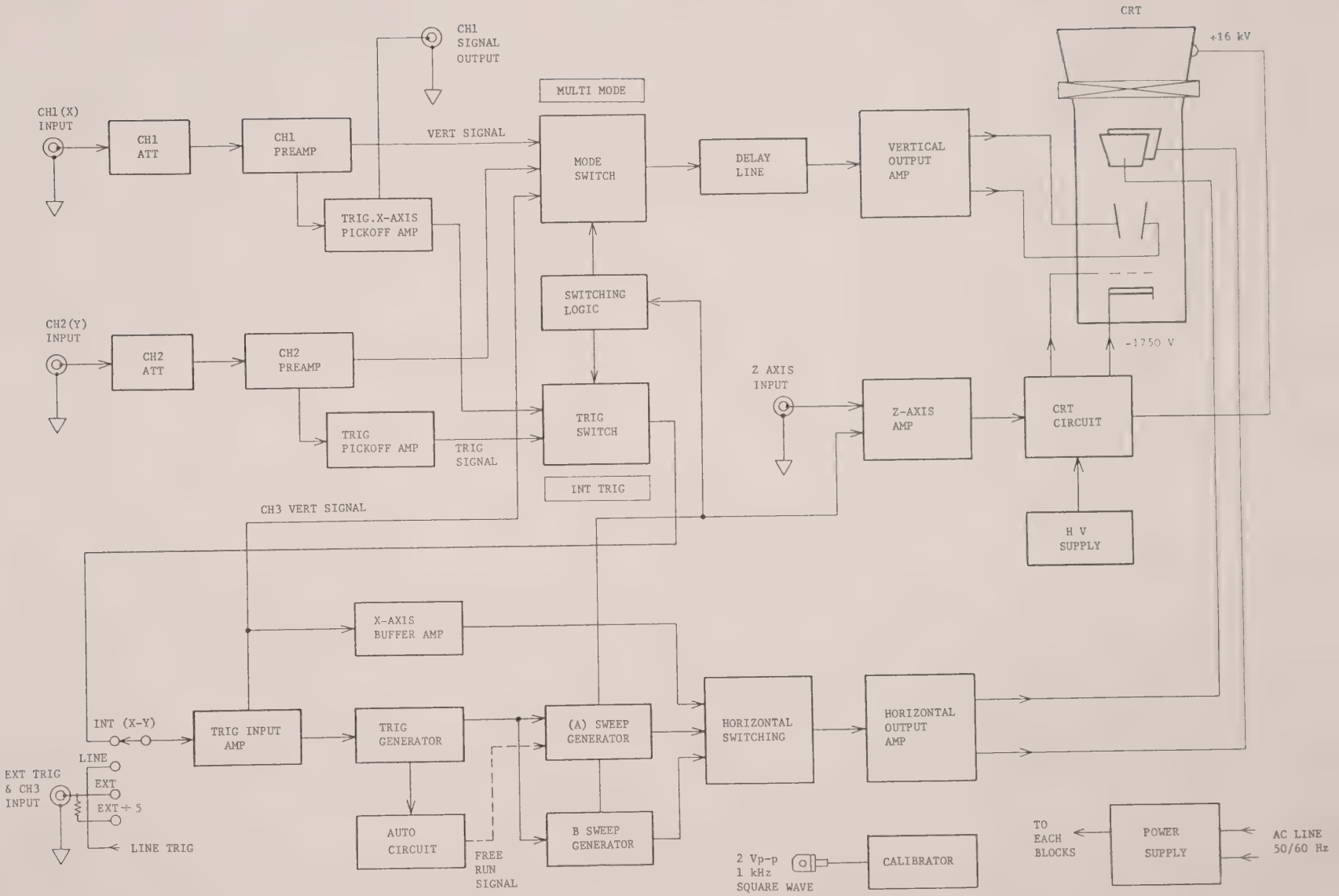
Figure 4-7



UPPER PRINTED CIRCUIT BOARD

Figure 4-9





BLOCK DIAGRAM

CIRCUIT SCHEMATICS

VERTICAL PREAMP CIRCUIT ◇1

VERTICAL AMP & SWITCHING CIRCUIT ◇2

VERTICAL FINAL AMP & TRIGGER CIRCUIT ◇3

A, B SWEEP GENERATOR & HOR FINAL AMP CIRCUIT ◇4

POWER SUPPLY & CRT CIRCUIT ◇5

NOTES

Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.

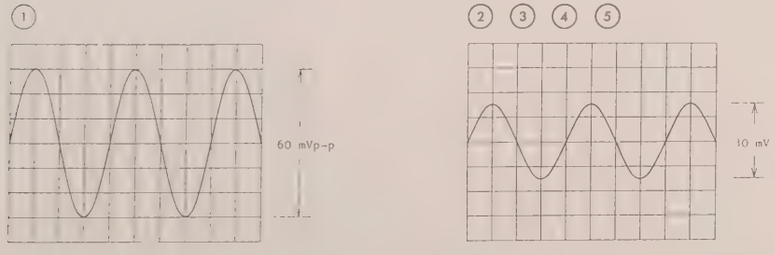
* Optimum value selected at factory. Average value shown.

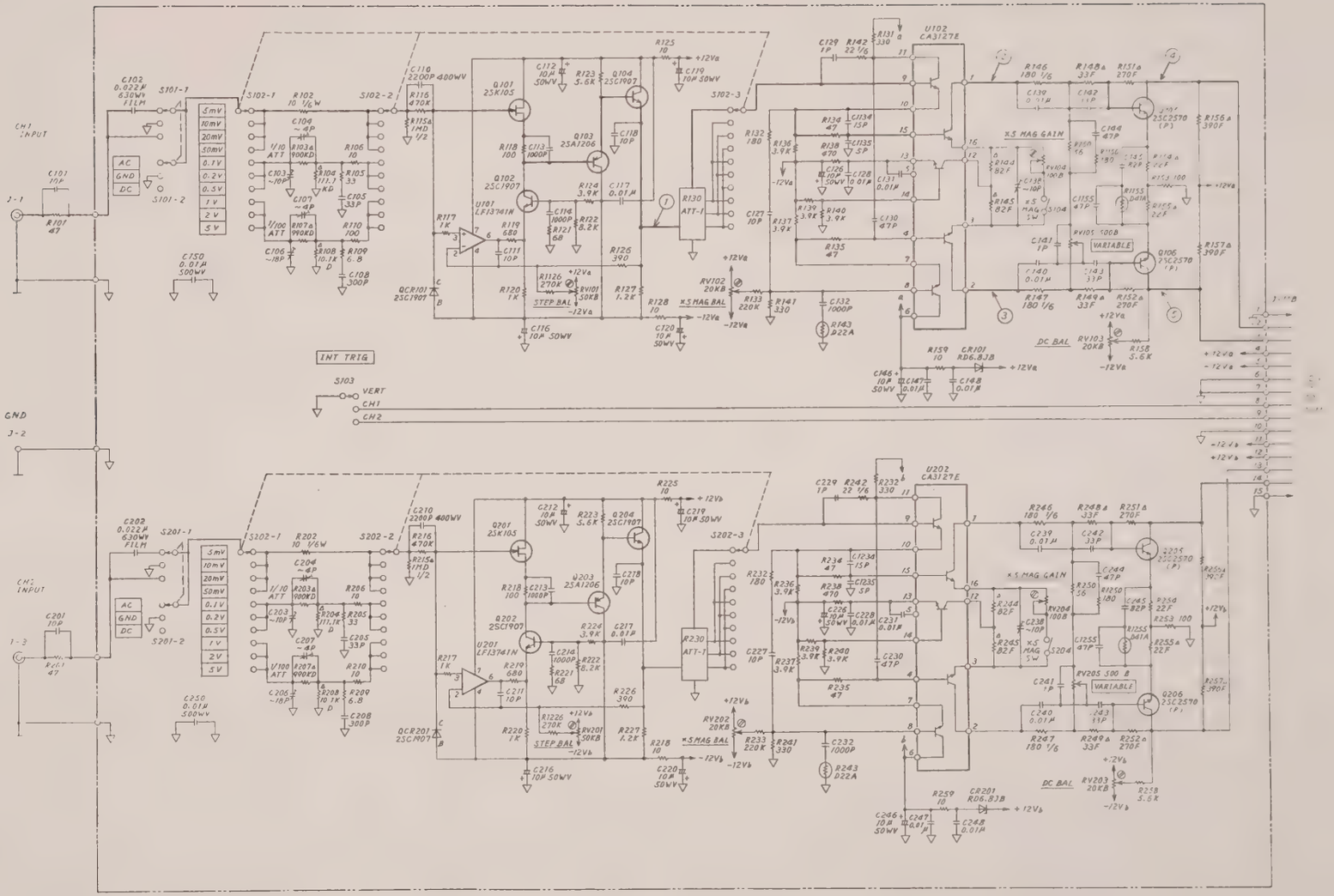
(Parts may be omitted.)

△ Metal film resistor.

⊘ Screwdriver adjustment.

① ② ③ ④ ⑤





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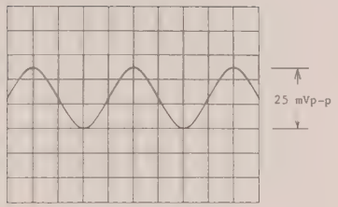

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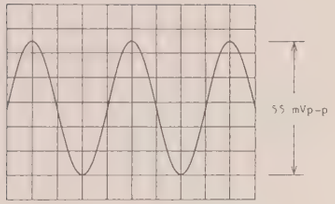

COS5100

VERTICAL AMP & SWITCHING CIRCUIT ②

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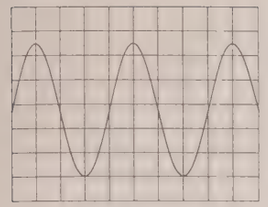

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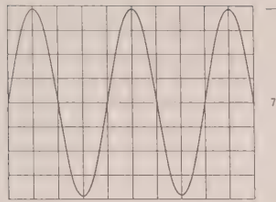

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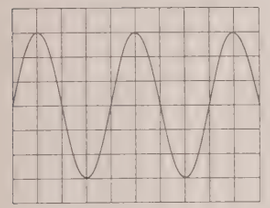

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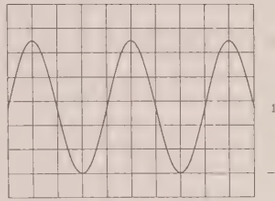

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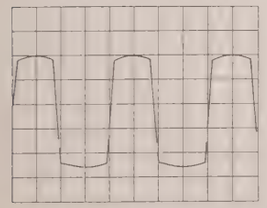

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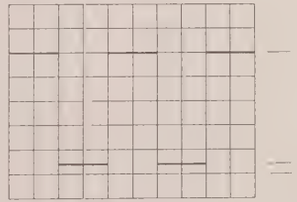

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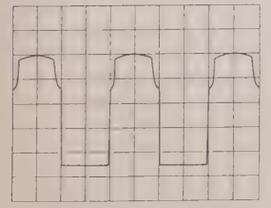

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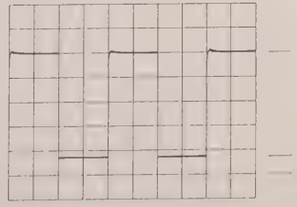

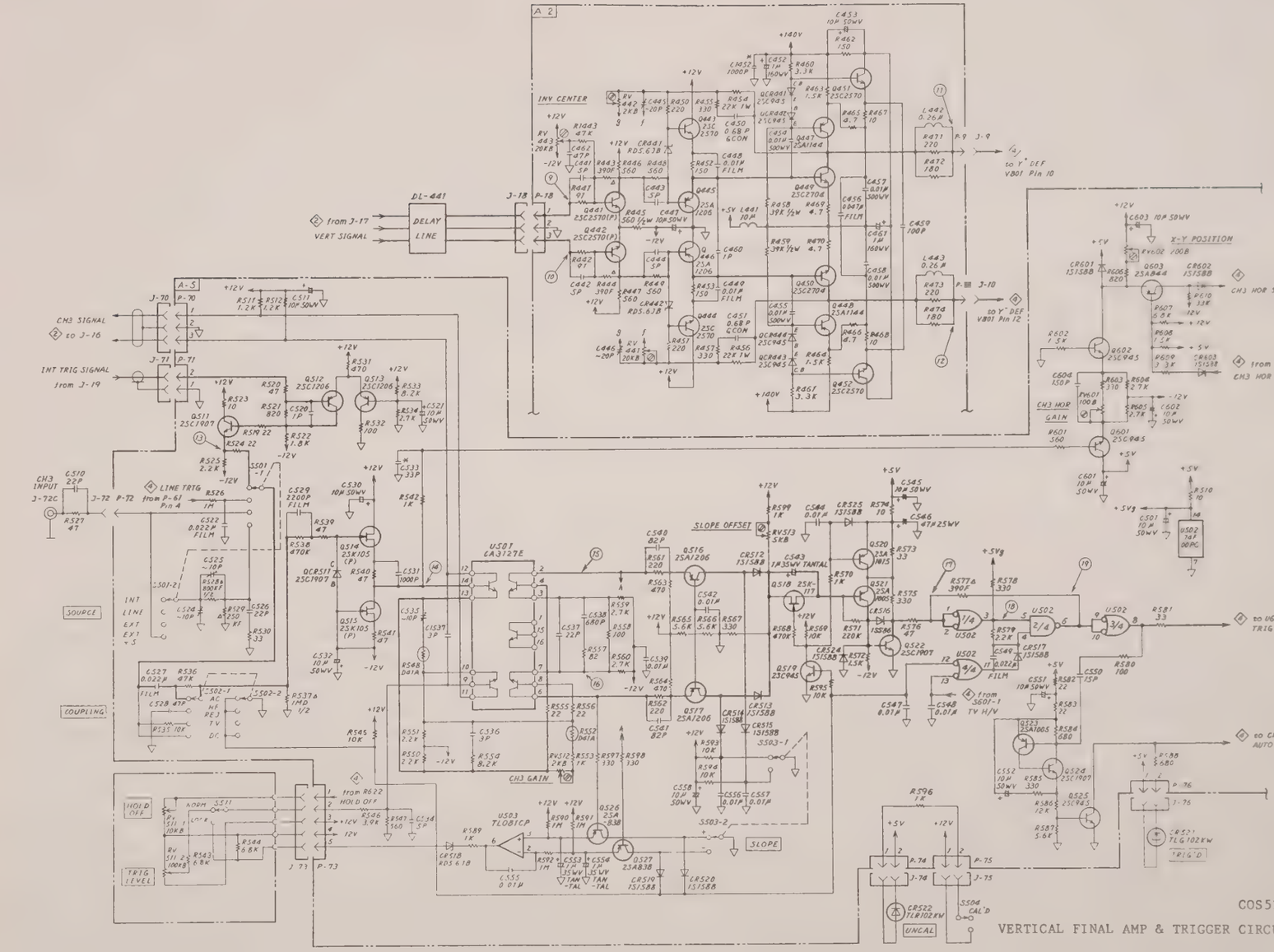

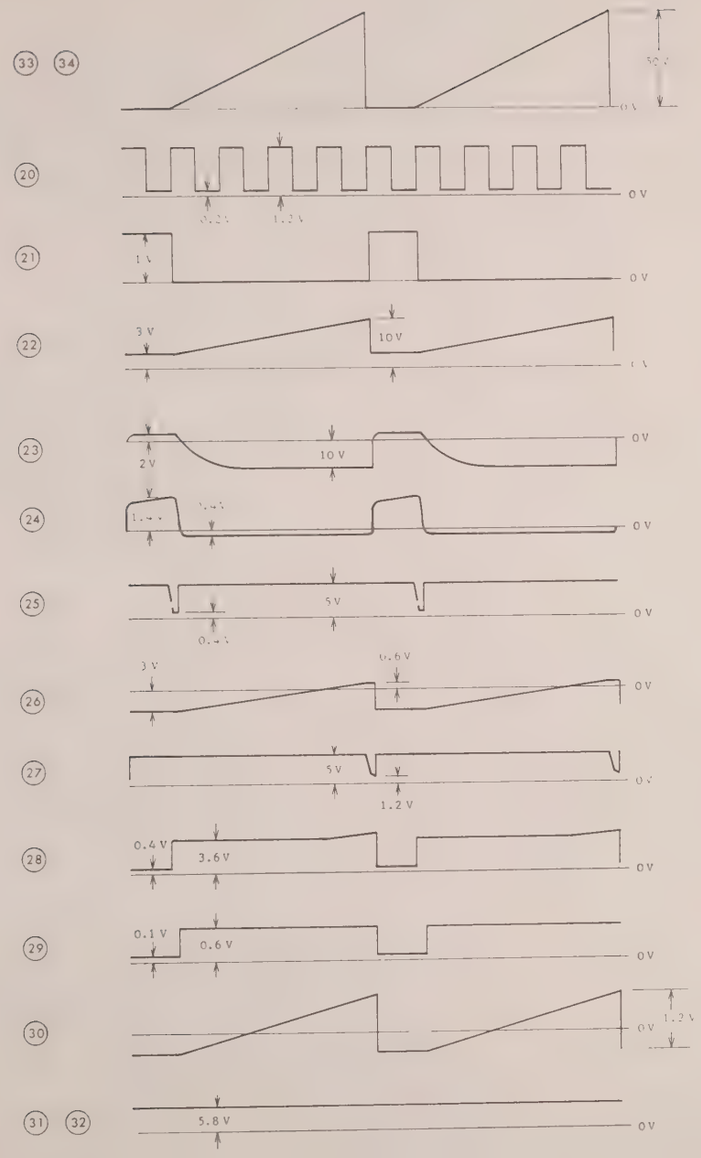
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27
5 V
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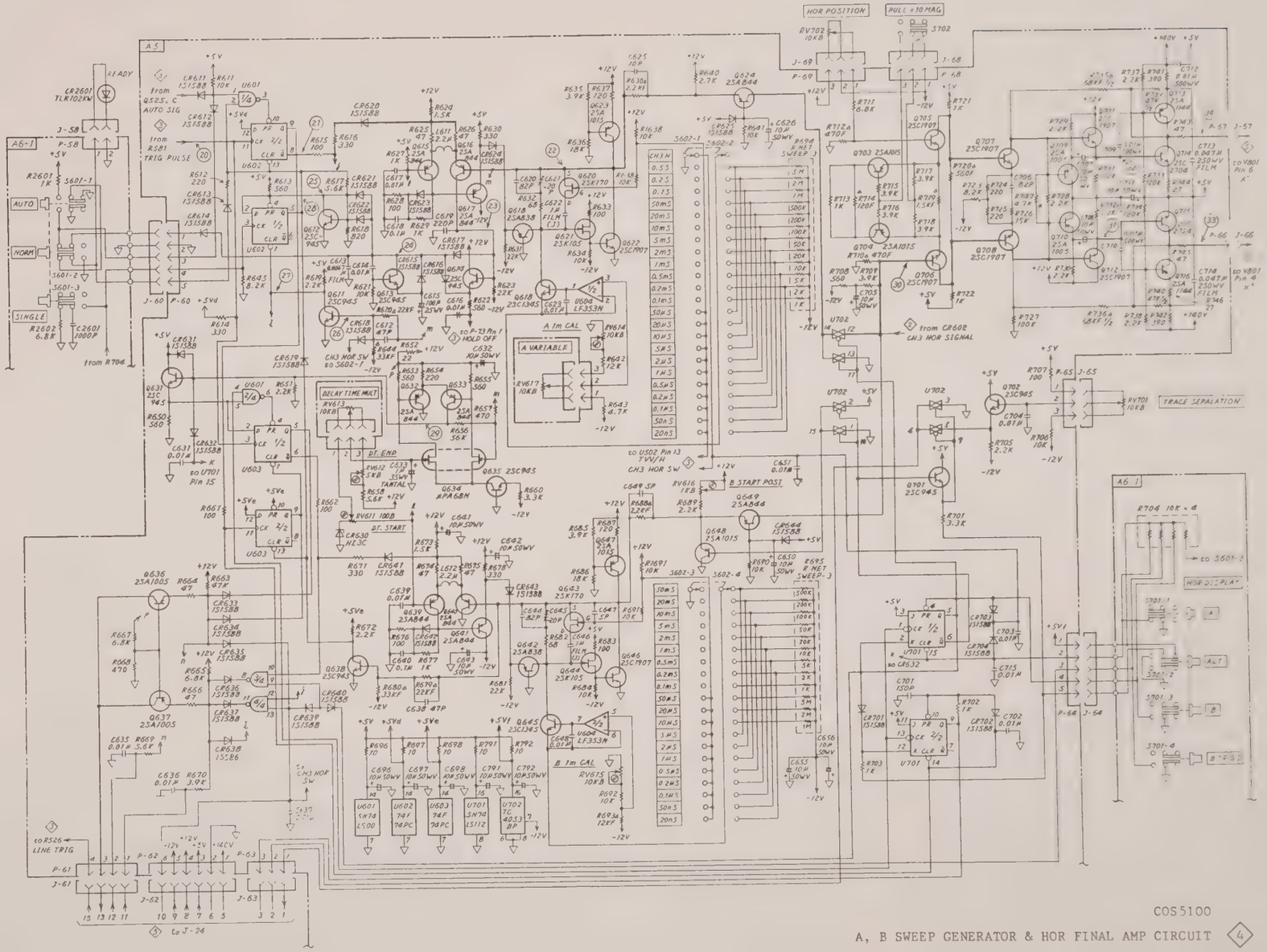
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READY
AUTO
NORM
SINGLE
A VARIABLE
A 1m CAL
B 1m CAL
DLY TIME MULT
DT END
DT START
B START POSI
TRACE SEPARATION
CH3 HOR SIGNAL
HOR DISPLAY
ALT
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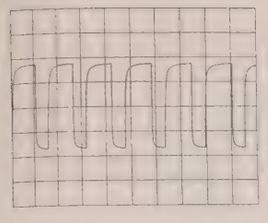
B
A, B SWEEP GENERATOR & HOR FINAL AMP CIRCUIT
COS5100
4

(35)



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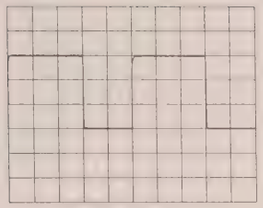

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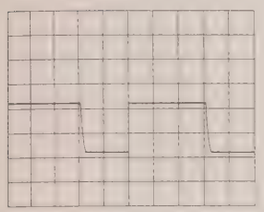

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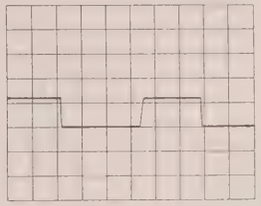

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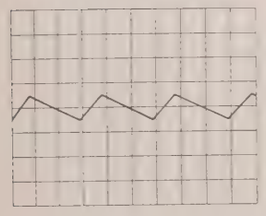

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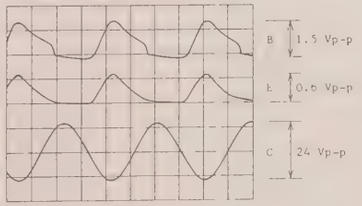

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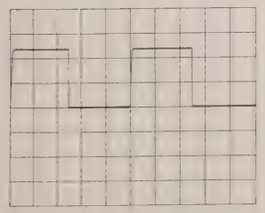
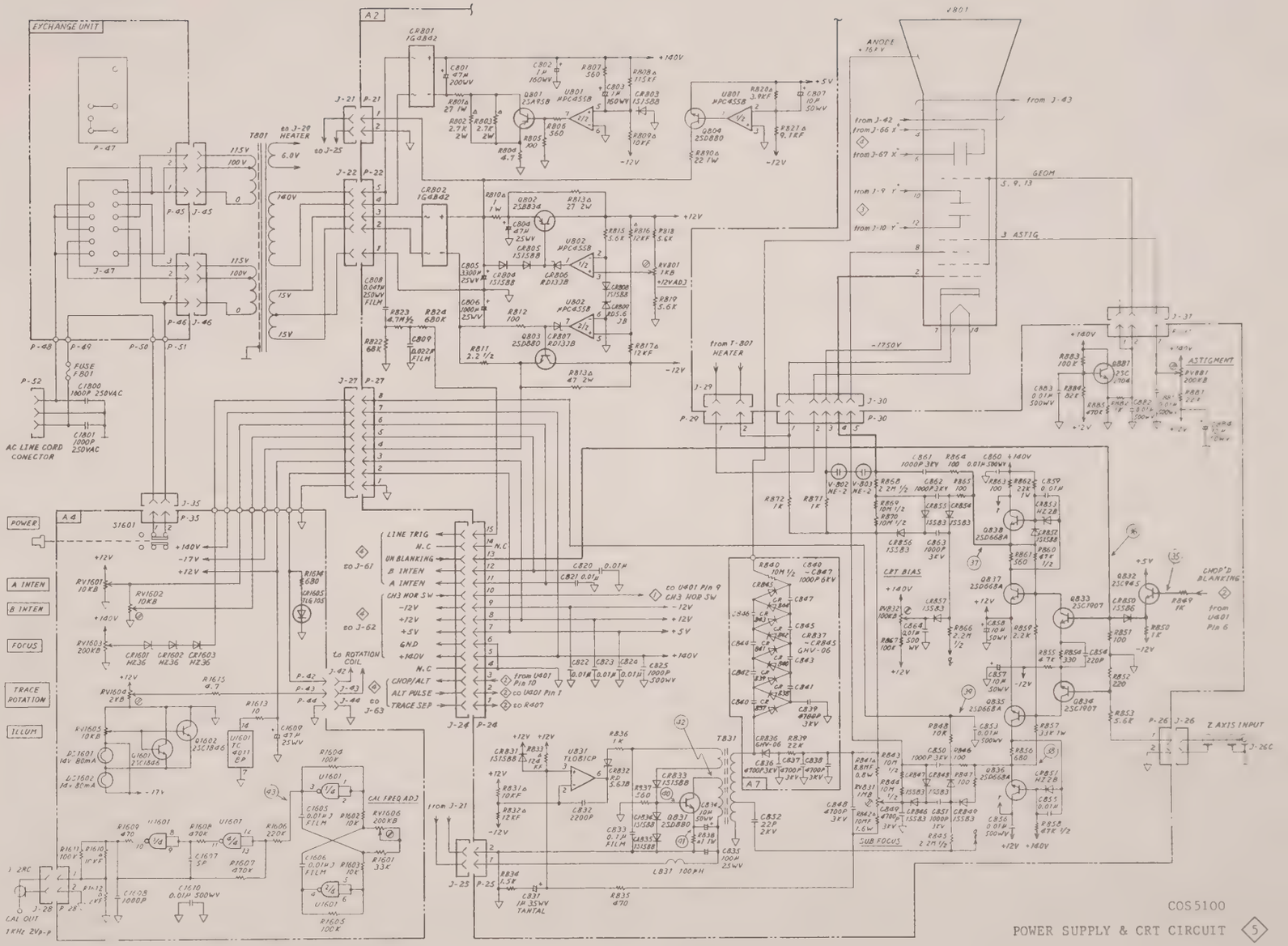
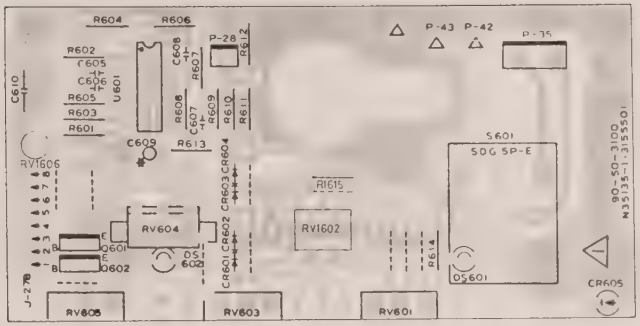
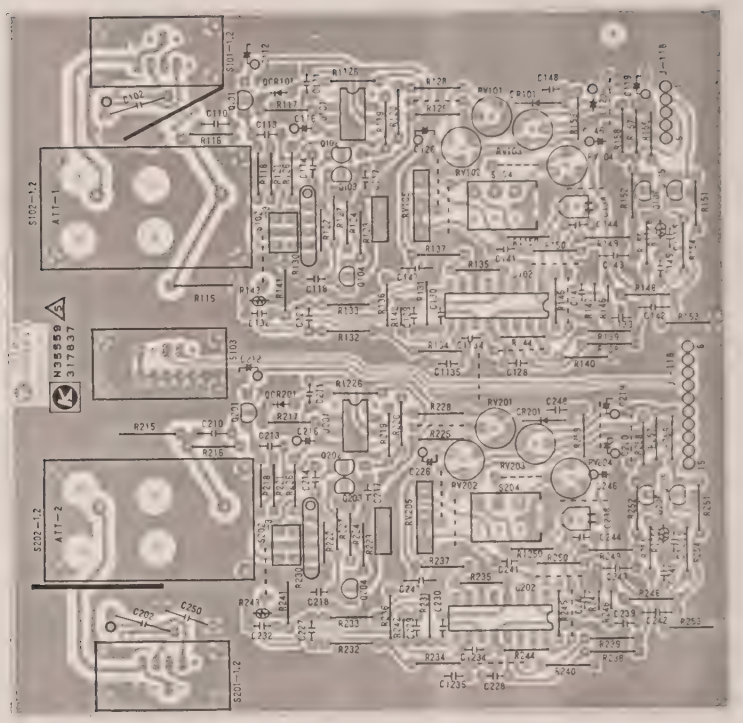






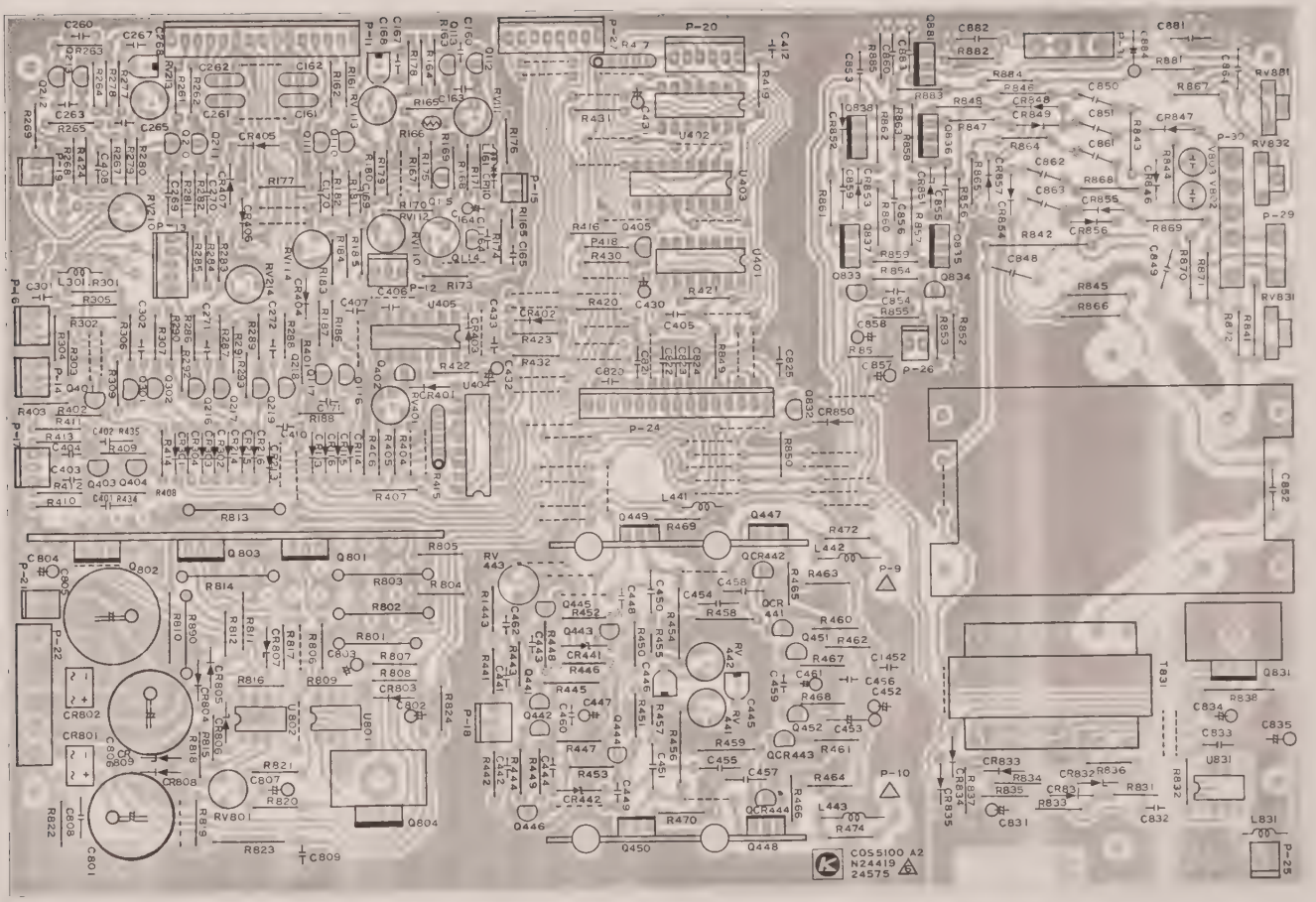
Cal & CRT Control A4 Parts Location Diagram

(Parts Side Veiw)

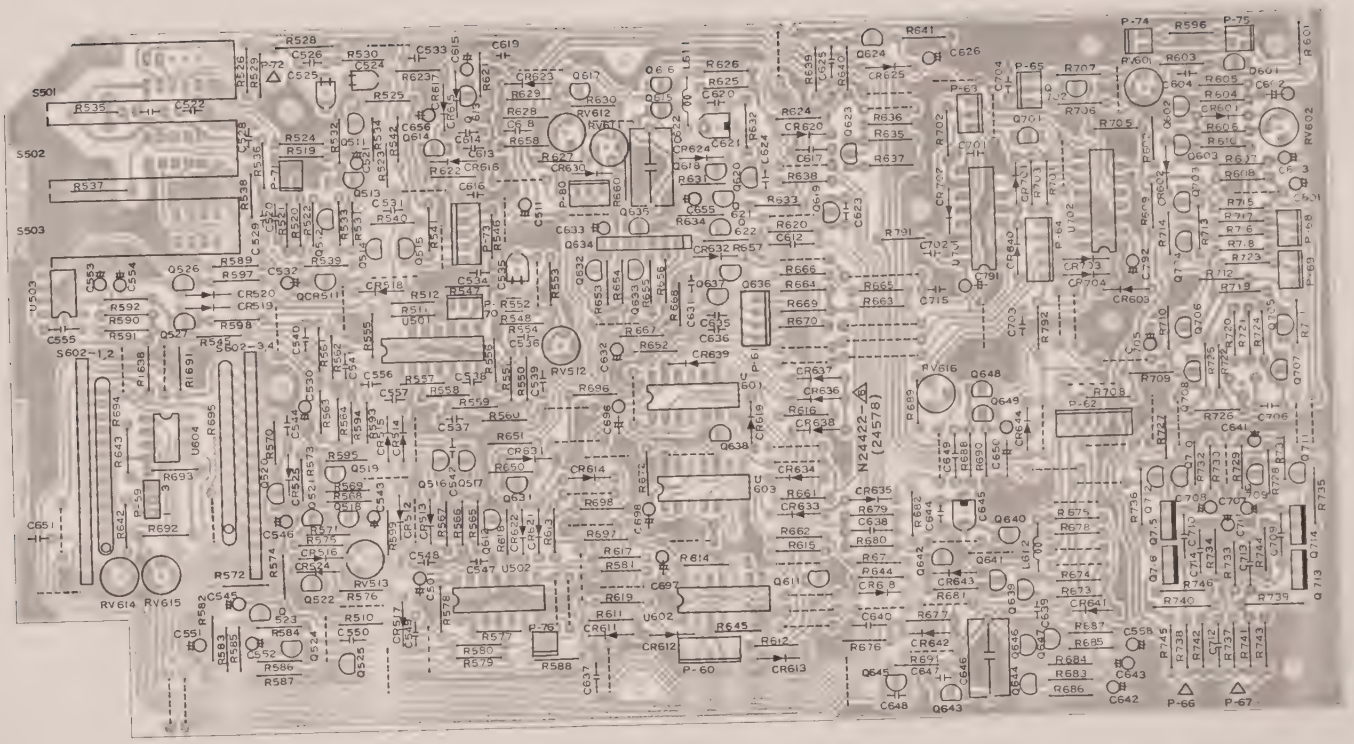


Vert Preamp A1 Parts Location Diagram

(Parts Side Veiw)

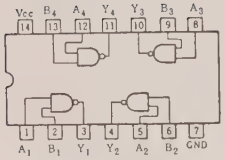


Vert Main Amp A2 Parts Location Diagram (Parts Side Veiw)

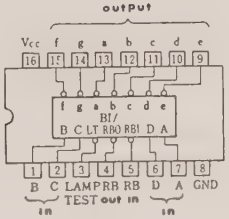


Sweep & Horiz Amp A5 Parts Location Diagram (Parts Side Veiw)

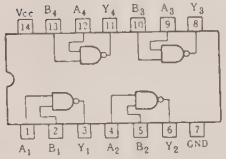
DIGITAL & ANALOG ICs



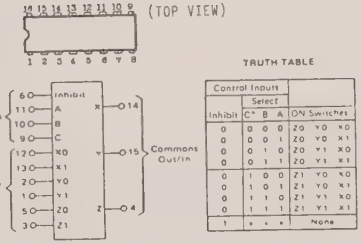
(TOP VIEW)
TC4011BP



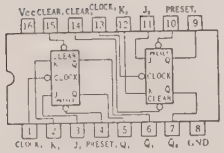
(TOP VIEW)
SN74LS47N



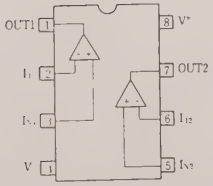
(TOP VIEW)
SN74LS00N
74F00PC



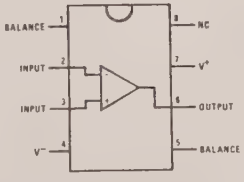
TC4053BP


Vcc CLEAR1 CLEAR2 CLOCK1 K1 J1 PRESET1
16 15 14 13 12 11 10 9
CLEAR
CLOCK
PRESET
CLOCK
CLEAR
1 2 3 4 5 6 7 8
CLOCK1 K1 J1 PRESET1 Q1 Q1 Q2 GND

(TOP VIEW)
74F74PC
SN74LS112N

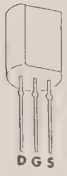


(TOP VIEW)
μPC4558C
LF353N

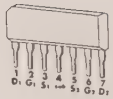


(TOP VIEW)
LF13741N
TL081CP

FET



2SK105-H
2SK117-BL
2SK170-V



μPA68H

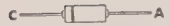
LED

TLG-105

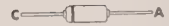
TLG102KW
TLR102KW

DIODE

GHV-06SSN



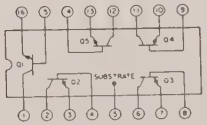
1S1588



1SS83 RD5.6JB
1SS86 RD6.8JB
HZ2B RD13JB
HZ36 HZ3C

1G4B42

TRANSISTOR ARRAY



(TOP VIEW)
CA3127E

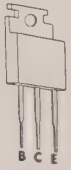
TRANSISTOR

2SA844-D
2SC1907

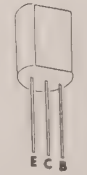
2SA1161
2SC2570

2SA1144-O
2SC1846
2SC2704-O
2SD668A

2SA1206-L



2SA958
2SB834-Y
2SD880-Y



2SA838-B
2SA1005-L
2SA1015-Y
2SC945-Q
2SC1345P-E

SEMICONDUCTOR LEAD CONFIGURATION

REPLACEABLE PARTS

ABBREVIATIONS

CER:	CERAMIC
C FILM:	CARBON FILM
C COMP:	CARBON COMPOSITION
CRT:	CATHODE RAY TUBE
ELECT:	ELECTROLYTIC
FET:	FIELD EFFECT TRANSISTOR
FXD:	FIXED
LED:	LIGHT EMITTING DIODE
M FILM:	METAL FILM
M GLAZE:	METAL GLAZE
M OX:	METAL OXIDE
M PLSTC FILM:	METALLIZED PLASTIC FILM
PLSTC FILM:	PLASTIC FILM
Si:	SILICON
TANT ELECT:	TANTALUM ELECTROLYTIC
VAR:	VARIABLE
WW:	WIREWOUND
*:	OPTIMUM VALUE SELECTED AT FACTORY. AVERAGE VALUE SHOWN.(PART MAY BE OMITTED.)

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
A ASSEMBLY			
B ASSEMBLY			
C101	52-06-3102	FXD CER 10PF 10% 500V TYPE1	
C201	52-06-3102	FXD CER 10PF 10% 500V TYPE1	
C510	52-06-3145	FXD CER 22PF 10% 500V TYPE1	
C1800	52-77-1000	FXD CER 100PF 250VAC	
C1801	52-77-1000	FXD CER 100PF 250VAC	
CR521	37-00-0092	LAMP LED RED	TOSHIBA TLG102KW
CR522	37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
CR2601	37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
DL441	91-90-0006	DELAY LINE	SUMITOMO
F801	99-00-0104	FUSE-1A SB	
L801	66-21-0081	ROTATION COIL	
P45	84-80-0301	CONNECTOR P RIGHT ANGLE	
P46	84-80-0301	CONNECTOR P RIGHT ANGLE	
R101	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R201	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R527	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
RV301	45-35-3103	VAR C COMP 10K OHM	
RV613	49-26-3100	POTENTIOMETOR 10K OHM	
RV701	45-20-3101	VAR M GLAZE 10K OHM B	
RV702	45-35-3103	VAR C COMP 10K OHM	
S1601	81-01-0270	PUSH SWITCH	ALPS SDG5P-E
T801	60-44-0160	POWER TRANS	KIKUSUI S8306861
V801	21-46-0607	CRT	
A1 ASSEMBLY			
ATT-1	80-98-0800	ROTARY SW WITH ATTENUATOR	
ATT-2	80-98-0800	ROTARY SW WITH ATTENUATOR	
C102	50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V	
C110	50-87-0510	FXD PLSTC FILM 2200PF 20% 400V	
C111	52-06-3102	FXD CER 10PF 10% 500V TYPE1	
C112	54-00-0311	FXD ELECT 10UF 50V	
C113	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	

EFERENCE ESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
C114	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C116	54-00-0311	FXD ELECT 10UF 50V
C117	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C118	52-06-3102	FXD CER 10PF 10% 500V TYPE1
C119	54-00-0311	FXD ELECT 10UF 50V
C120	54-00-0311	FXD ELECT 10UF 50V
C126	54-00-0311	FXD ELECT 10UF 50V
C127	52-06-3102	FXD CER 10PF 10% 500V TYPE1
C128	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C129	52-06-3010	FXD CER 1PF 500V TYPE1
C130	52-06-2184	FXD CER 47PF 10% 50V TYPE1
C131	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C132	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C138	57-10-1191	VAR CER 3-10PF
C139	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C140	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C141	52-06-3010	FXD CER 1PF 500V TYPE1
C142	52-06-3165	FXD CER 33PF 10% 500V TYPE1
C143	52-06-3165	FXD CER 33PF 10% 500V TYPE1
C144	52-06-2184	FXD CER 47PF 10% 50V TYPE1
C145	52-06-2215	FXD CER 82PF 10% 500V TYPE1
C146	54-00-0311	FXD ELECT 10UF 50V
C147	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C148	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C202	50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V
C210	50-87-0510	FXD PLSTC FILM 2200PF 20% 400V
C211	52-06-3102	FXD CER 10PF 10% 500V TYPE1
C212	54-00-0311	FXD ELECT 10UF 50V
C213	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C214	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C216	54-00-0311	FXD ELECT 10UF 50V
C217	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C218	52-06-3102	FXD CER 10PF 10% 500V TYPE1
C219	54-00-0311	FXD ELECT 10UF 50V
C220	54-00-0311	FXD ELECT 10UF 50V
C226	54-00-0311	FXD ELECT 10UF 50V
C227	52-06-3102	FXD CER 10PF 10% 500V TYPE1
C228	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C229	52-06-3010	FXD CER 1PF 500V TYPE1
C230	52-06-2184	FXD CER 47PF 10% 50V TYPE1
C231	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C232	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C238	57-10-1191	VAR CER 3-10PF
C239	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C240	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C241	52-06-3010	FXD CER 1PF 500V TYPE1
C242	52-06-3165	FXD CER 33PF 10% 500V TYPE1
C243	52-06-3165	FXD CER 33PF 10% 500V TYPE1
C244	52-06-2184	FXD CER 47PF 10% 50V TYPE1
C245	52-06-2215	FXD CER 82PF 10% 500V TYPE1
C246	54-00-0311	FXD ELECT 10UF 50V
C247	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C248	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C250	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
C1134	52-06-3125	FXD CER 15PF 10% 500V TYPE1	
C1150	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C1155	52-06-2184	FXD CER 47PF 10% 50V TYPE1	
C1234	52-06-3125	FXD CER 15PF 10% 500V TYPE1	
C1255	52-06-2184	FXD CER 47PF 10% 50V TYPE1	
CR101	32-92-0068	ZENER VZ 6.4-7.2V P 0.4W	NEC RD6.8J
CR201	32-92-0068	ZENER VZ 6.4-7.2V P 0.4W	NEC RD6.8J
Q101	31-20-1051	FET	NEC 2SK105-H
Q102	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q103	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q104	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q105	30-32-5701	TR SI NPN PAIR	KIKUSUI S8309591
Q106	30-32-5701	TR SI NPN PAIR	KIKUSUI S8309591
Q201	31-20-1051	FET	NEC 2SK105-H
Q202	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q203	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q204	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q205	30-32-5701	TR SI NPN PAIR	KIKUSUI S8309591
Q206	30-32-5701	TR SI NPN PAIR	KIKUSUI S8309591
QCR101	30-31-9071	TR SI NPN	HITACHI 2SC1907
QCR201	30-31-9071	TR SI NPN	HITACHI 2SC1907
R115	42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W	100PPM/DEG
R116	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R117	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R118	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R119	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R120	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R121	40-27-0682	FXD C FILM 68 OHM 5% 1/4W	
R122	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R123	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R124	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R125	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R126	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R127	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R128	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R130	44-04-6000	FXD M GLAZE R-NETWORK	KIKUSUI S8109001
R131	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R132	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R133	40-27-4222	FXD C FILM 220K OHM 5% 1/4W	
R134	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R135	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R136	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R137	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R138	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R139	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R140	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R141	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R142	40-16-0220	FXD C FILM 22 OHM 5% 1/6W	
R143	38-00-0070	THERMISTOR 200 OHM	
R144	42-83-0820	FXD M FILM 82 OHM 1% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
R145	42-83-0820	FXD M FILM 82 OHM 1% 1/4W	
R146	40-16-1180	FXD C FILM 180 OHM 5% 1/6	
R147	40-16-1180	FXD C FILM 180 OHM 5% 1/6	
R148	42-83-0330	FXD M FILM 33 OHM 1% 1/4W	
R149	42-83-0330	FXD M FILM 33 OHM 1% 1/4W	
R150	40-27-0562	FXD C FILM 56 OHM 5% 1/4W	
R151	42-83-1270	FXD M FILM 270 OHM 1% 1/4W	
R152	42-83-1270	FXD M FILM 270 OHM 1% 1/4W	
R153	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R154	42-83-0220	FXD M FILM 22 OHM 1% 1/4W	
R155	42-83-0220	FXD M FILM 22 OHM 1% 1/4W	
R156	42-83-1390	FXD M FILM 390 OHM 1% 1/4W	
R157	42-83-1390	FXD M FILM 390 OHM 1% 1/4W	
R158	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R159	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R215	42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W	100PPM/DEG
R216	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R217	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R218	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R219	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R220	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R221	40-27-0682	FXD C FILM 68 OHM 5% 1/4W	
R222	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R223	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R224	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R225	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R226	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R227	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R228	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R230	44-04-0000	FXD M GLAZE R-NETWORK	KIKUSUI S8109001
R231	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R232	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R233	40-27-4222	FXD C FILM 220K OHM 5% 1/4W	
R234	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R235	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R236	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R237	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R238	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R239	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R240	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R241	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R242	40-16-0220	FXD C FILM 22 OHM 5% 1/6W	
R243	38-00-0070	THERMISTOR 200 OHM	
R244	42-83-0820	FXD M FILM 82 OHM 1% 1/4W	
R245	42-83-0820	FXD M FILM 82 OHM 1% 1/4W	
R246	40-16-1180	FXD C FILM 180 OHM 5% 1/6	
R247	40-16-1180	FXD C FILM 180 OHM 5% 1/6	
R248	42-83-0330	FXD M FILM 33 OHM 1% 1/4W	
R249	42-83-0330	FXD M FILM 33 OHM 1% 1/4W	
R250	40-27-0562	FXD C FILM 56 OHM 5% 1/4W	
R251	42-83-1270	FXD M FILM 270 OHM 1% 1/4W	
R252	42-83-1270	FXD M FILM 270 OHM 1% 1/4W	
R253	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R254	42-83-0220	FXD M FILM 22 OHM 1% 1/4W	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
R255		42-83-0220	FXD M FILM 22 OHM 1% 1/4W	
R256		42-83-1390	FXD M FILM 390 OHM 1% 1/4W	
R257		42-83-1390	FXD M FILM 390 OHM 1% 1/4W	
R258		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R259		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1126		40-27-4272	FXD C FILM 270K OHM 5% 1/4W	
R1150		40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R1155		38-00-0090	THERMISTOR 40 OHM	
R1226		40-27-4272	FXD C FILM 270K OHM 5% 1/4W	
R1250		40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R1255		38-00-0090	THERMISTOR 40 OHM	
RV101		48-33-3500	VAR M FILM 50K OHM	
RV102		48-33-3200	VAR M FILM 20K OHM	
RV103		48-33-3200	VAR M FILM 20K OHM	
RV104		48-33-1100	VAR M FILM 100 OHM	
RV201		48-33-3500	VAR M FILM 50K OHM	
RV202		48-33-3200	VAR M FILM 20K OHM	
RV203		48-33-3200	VAR M FILM 20K OHM	
RV204		48-33-1100	VAR M FILM 100 OHM	
S101		82-70-5231	LEVER SWICH	
S103		82-70-5231	LEVER SWICH	
S201		82-70-5231	LEVER SWICH	
U101		34-00-0121	FET OPEAMP	N.S LF13741N
U102		30-90-0150	TRANSISTOR ARRAYS 5 NPN	RCA CA3127E
U201		34-00-0121	FET OPEAMP	N.S LF13741N
U202		30-90-0150	TRANSISTOR ARRAYS 5 NPN	RCA CA3127E
A2 ASSEMBLY				
C160	*	52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C161		56-48-1000	FXD CER EMI FILTER	
C162		56-48-1000	FXD CER EMI FILTER	
C163		52-06-2204	FXD CER 68P 10% 50V TYPE1	
C164		54-00-0311	FXD ELECT 10UF 50V	
C165		52-06-2245	FXD CER 150PF 10% 50V TYPE1	
C167		52-06-2204	FXD CER 68P 10% 50V TYPE1	
C168		57-10-1223	VAR CER 8-50PF	
C169		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C170		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C171		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C260	*	52-06-3030	FXD CER 3PF 10% 500V TYPE1	
C261		56-48-1000	FXD CER EMI FILTER	
C262		56-48-1000	FXD CER EMI FILTER	
C263		52-06-2204	FXD CER 68P 10% 50V TYPE1	
C265		52-06-3125	FXD CER 15PF 10% 500V TYPE1	
C267		52-06-2204	FXD CER 68P 10% 50V TYPE1	
C268		57-10-1223	VAR CER 8-50PF	
C269		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C270		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
C271		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C272		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C301		52-06-2184	FXD CER 47PF 10% 50V TYPE1
C302		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C303		52-06-3030	FXD CER 3PF 10% 500V TYPE1
C401	*	52-06-3030	FXD CER 3PF 10% 500V TYPE1
C402	*	52-06-3030	FXD CER 3PF 10% 500V TYPE1
C403		52-06-2184	FXD CER 47PF 10% 50V TYPE1
C404		52-06-2184	FXD CER 47PF 10% 50V TYPE1
C405		52-01-3325	FXD CER 680PF 10% 500V TYPE2
C406		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C407		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C408		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C410		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C412		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C430		54-00-0311	FXD ELECT 10UF 50V
C431		54-00-0311	FXD ELECT 10UF 50V
C432		54-00-0311	FXD ELECT 10UF 50V
C433		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C441		52-06-3051	FXD CER 5PF 10% 500V TYPE1
C442		52-06-3051	FXD CER 5PF 10% 500V TYPE1
C443	*	52-06-3051	FXD CER 5PF 10% 500V TYPE1
C444	*	52-06-3051	FXD CER 5PF 10% 500V TYPE1
C445		57-10-1203	VAR CER 5-20PF
C446		57-10-1203	VAR CER 5-20PF
C447		54-00-0311	FXD ELECT 10UF 50V
C448		50-67-0030	FXD PLSTC FILM 0.01UF 10% 100V
C449		50-67-0030	FXD PLSTC FILM 0.01UF 10% 100V
C450		52-96-1160	GCON CGM 0.47PF
C451		52-96-1160	GCON CGM 0.47PF
C452		54-60-1550	FXD ELECT 1UF 160V
C453		54-00-0311	FXD ELECT 10UF 50V
C454		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C455		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C456		50-67-0050	FXD PLSTC FILM 0.047UF 10% 100V
C457		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C458		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C459		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C460		52-06-3010	FXD CER 1PF 500V TYPE1
C461		54-60-1550	FXD ELECT 1UF 160V
C462		52-06-2184	FXD CER 47PF 10% 50V TYPE1
C462		52-06-2184	FXD CER 47PF 10% 50V TYPE1
C801		54-60-1730	FXD ELECT 47UF 200V
C802		54-60-1550	FXD ELECT 1UF 160V
C803		54-60-1550	FXD ELECT 1UF 160V
C804		54-00-0114	FXD ELECT 47UF 25V
C805		54-30-1810	FXD ELECT 3300UF 25V
C806		54-30-1830	FXD ELECT 1000UF 25V
C807		54-00-0311	FXD ELECT 10UF 50V
C808		50-77-3500	FXD PLSTC FILM 0.047UF 20% 250V
C809		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V
C820		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C821		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C822		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
C823		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C824		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C825		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C831		55-37-2050	FXD TANT ELECT 1UF 35V	
C832		52-01-3355	FXD CER 2220PF 10% 500V TYPE2	
C833		50-67-0050	FXD PLSTC FILM 0.1UF 10% 100V	
C834		54-00-0311	FXD ELECT 10UF 50V	
C835		54-00-0121	FXD ELECT 100UF 25V	
C848		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1	
C849		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1	
C850		52-98-1020	FXD CER 1000PF +80 - -20% 3.15KV	
C851		52-98-1020	FXD CER 1000PF +80 - -20% 3.15KV	
C852		52-03-5145	FXD CER 22PF 10% 2KV TYPE1	
C853		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C854		52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C855		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C856		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C857		54-00-0311	FXD ELECT 10UF 50V	
C858		54-00-0311	FXD ELECT 10UF 50V	
C859		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C860		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C861		52-98-1020	FXD CER 1000PF +80 - -20% 3.15KV	
C862		52-98-1020	FXD CER 1000PF +80 - -20% 3.15KV	
C863		52-98-1020	FXD CER 1000PF +80 - -20% 3.15KV	
C864		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C881		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C882		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C883		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C884		54-00-0311	FXD ELECT 10UF 50V	
C1160		52-06-3030	FXD CER 3PF 10% 500V TYPE1	
C1164		52-06-2245	FXD CER 150PF 10% 50V TYPE1	
C1260		52-06-3030	FXD CER 3PF 10% 500V TYPE1	
C1452	*	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
CR110		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR113		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR114		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR115		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR116		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR213		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR214		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR215		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR216		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR301		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR302		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR303		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR304		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR401		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR402		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR403		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR404		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR405		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR406		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR407		32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR441	32-92-0056	ZENER VZ 5.5-5.8V P 0.4W	NEC RD5.6J
CR442	32-92-0056	ZENER VZ 5.5-5.8V P 0.4W	NEC RD5.6J
CR801	32-90-2110	DIODE BRIDGE VRM 400V IO 1A	TOSHIBA 1G4B42
CR802	32-90-2110	DIODE BRIDGE VRM 400V IO 1A	TOSHIBA 1G4B42
CR803	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR804	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR805	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR806	32-92-0130	ZENER VZ 12.41-13.05V P 0.4W	NEC RD13J
CR807	32-92-0130	ZENER VZ 12.41-13.05V P 0.4W	NEC RD13J
CR808	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR809	32-92-0056	ZENER VZ 5.5-5.8V P 0.4W	NEC RD5.6J
CR831	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR832	32-92-0056	ZENER VZ 5.5-5.8V P 0.4W	NEC RD5.6J
CR833	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR834	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR835	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR846	32-30-0830	DIODE VR 250V IO 200MA	HITACHI 1SS83
CR847	32-30-0830	DIODE VR 250V IO 200MA	HITACHI 1SS83
CR848	32-30-0830	DIODE VR 250V IO 200MA	HITACHI 1SS83
CR849	32-30-0830	DIODE VR 250V IO 200MA	HITACHI 1SS83
CR850	32-30-0860	DIODE VR 30V IO 30MA	HITACHI 1SS86
CR851	32-92-0022	ZENER VZ 2.1-2.3V	HITACHI HZ2B-3
CR852	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR853	32-92-0022	ZENER VZ 2.1-2.3V	HITACHI HZ2B-3
CR854	32-30-0830	DIODE VR 250V IO 200MA	HITACHI 1SS83
CR855	32-30-0830	DIODE VR 250V IO 200MA	HITACHI 1SS83
CR856	32-30-0830	DIODE VR 250V IO 200MA	HITACHI 1SS83
CR857	32-30-0830	DIODE VR 250V IO 200MA	HITACHI 1SS83
L161	67-10-0870	INDUCTOR 1UH	
L301	67-10-0870	INDUCTOR 1UH	
L441	67-10-0940	INDUCTOR 10UH 10%	
L442	67-95-0010	INDUCTOR L-2874	
L443	67-95-0010	INDUCTOR L-2874	
L831	67-10-0890	INDUCTOR 100MH 10%	
P9	87-40-0040	DIAMOND CONECTOR PIN	
P10	87-40-0040	DIAMOND CONECTOR PIN	
P11	84-80-0277	CONNECTOR P FLAT WAFER	
P12	84-80-0271	CONNECTOR P FLAT WAFER	
P13	84-80-0273	CONNECTOR P FLAT WAFER	
P14	84-80-0271	CONNECTOR P FLAT WAFER	
P15	84-80-0270	CONNECTOR P FLAT WAFER	
P16	84-80-0271	CONNECTOR P FLAT WAFER	
P17	84-80-0271	CONNECTOR P FLAT WAFER	
P18	84-80-0271	CONNECTOR P FLAT WAFER	
P19	84-80-0270	CONNECTOR P FLAT WAFER	
P20	84-80-0274	CONNECTOR P FLAT WAFER	
P21	84-80-0270	CONNECTOR P FLAT WAFER	
P22	84-80-0203	CONNECTOR P FLAT WAFER	
P24	84-80-0277	CONNECTOR P FLAT WAFER	
P25	84-80-0270	CONNECTOR P FLAT WAFER	
P26	84-80-0270	CONNECTOR P FLAT WAFER	
P27	84-80-0275	CONNECTOR P FLAT WAFER	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
P29	84-80-0200	CONNECTOR P FLAT WAFER	
P30	84-80-0203	CONNECTOR P FLAT WAFER	
P31	84-80-0201	CONNECTOR P FLAT WAFER	
Q110	30-11-1612	TR SI PNP PAIR	KIKUSUI S8310801
Q111	30-11-1612	TR SI PNP PAIR	KIKUSUI S8310801
Q112	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q113	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q114	30-32-5700	TR SI NPN	NEC 2SC2570
Q115	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q116	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q117	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q210	30-11-1612	TR SI PNP PAIR	KIKUSUI S8310801
Q211	30-11-1612	TR SI PNP PAIR	KIKUSUI S8310801
Q212	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q213	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q216	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q217	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q218	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q219	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q301	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q302	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q401	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q402	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q403	30-11-2062	TR SI PNP PAIR	KIKUSUI S8309581
Q404	30-11-2062	TR SI PNP PAIR	KIKUSUI S8309581
Q405	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q441	30-32-5701	TR SI NPN PAIR	KIKUSUI S8309591
Q442	30-32-5701	TR SI NPN PAIR	KIKUSUI S8309591
Q443	30-32-5701	TR SI NPN PAIR	KIKUSUI S8309591
Q444	30-32-5701	TR SI NPN PAIR	KIKUSUI S8309591
Q445	30-11-2062	TR SI PNP PAIR	KIKUSUI S8309581
Q446	30-11-2062	TR SI PNP PAIR	KIKUSUI S8309581
Q447	30-11-1441	TR SI PNP	TOSHIBA 2SA1144-O
Q448	30-11-1441	TR SI PNP	TOSHIBA 2SA1144-O
Q449	30-32-7041	TR SI NPN	TOSHIBA 2SC2704-O
Q450	30-32-7041	TR SI NPN	TOSHIBA 2SC2704-O
Q451	30-32-5700	TR SI NPN	NEC 2SC2570
Q452	30-32-5700	TR SI NPN	NEC 2SC2570
Q801	30-10-9580	TR SI NPN PAIR	KIKUSUI S8309591
Q802	30-20-8341	TR SI PNP	TOSHIBA 2SB834-Y
Q803	30-40-8802	TR SI NPN	NEC 2SD880-Y
Q804	30-40-8802	TR SI NPN	NEC 2SD880-Y
Q831	30-40-8802	TR SI NPN	NEC 2SD880-Y
Q832	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q833	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q834	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q835	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q836	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q837	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q838	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q881	30-32-7041	TR SI NPN	TOSHIBA 2SC2704-O
QCR441	30-30-9451	TR SI NPN	NEC 2SC945-Q

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
QCR442		30-30-9451	TR SI NPN	NEC 2SC945-Q
QCR443		30-30-9451	TR SI NPN	NEC 2SC945-Q
QCR444		30-30-9451	TR SI NPN	NEC 2SC945-Q
R161		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R162		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R163		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R164		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R165		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R166		38-00-0070	THERMISTOR 200 OHM	
R167		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R168		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R169		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R170		40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W	
R171		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R172		40-27-0000	JUMPER PARTS	
R173		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R174		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R175		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R176		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R177		40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R178		40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R179		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R180		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R181		40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R182		40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R183		42-83-1100	FXD M FILM 100 OHM 1% 1/4W	
R184		40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R185		40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R186		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R187		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R188		40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R261		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R262		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R263		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R264		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R265		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R267		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R268		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R269	*	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R277		40-27-0562	FXD C FILM 56 OHM 5% 1/4W	
R278		40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R279		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R280		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R281		40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R282		40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R283		42-83-1100	FXD M FILM 100 OHM 1% 1/4W	
R284		40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R285		40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R286		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R287		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R288		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R289		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R290		40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R291	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4w
R292	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R293	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R301	40-27-0272	FXD C FILM 27 OHM 5% 1/4W
R302	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R303	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R304	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R305	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R306	40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R307	40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R309	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R401	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R402	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R403	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R404	40-27-1392	FXD C FILM 390 OHM 5% 1/4W
R405	40-27-1392	FXD C FILM 390 OHM 5% 1/4W
R406	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R407	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R408	42-83-1330	FXD M FILM 330 OHM 1% 1/4W
R409	42-83-1330	FXD M FILM 330 OHM 1% 1/4W
R410	40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R411	40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R412	40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R413	40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R414	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R415	44-07-0020	FXD M GLAZE RESISTOR NETWORKS 10K OHM X4
R416	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R417	44-07-0020	FXD M GLAZE RESISTOR NETWORKS 10K OHM X4
R418	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R419	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R420	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R421	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R422	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R423	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R424	40-27-1182	FXD C FILM 180 OHM 5% 1/4W
R430	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R431	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R432	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R434	40-16-1100	FXD C FILM 100 OHM 5% 1/6W
R435	40-16-1100	FXD C FILM 100 OHM 5% 1/6W
R441	40-27-0912	FXD C FILM 91 OHM 5% 1/4W
R442	40-27-0912	FXD C FILM 91 OHM 5% 1/4W
R443	42-83-1390	FXD M FILM 390 OHM 1% 1/4W
R444	42-83-1390	FXD M FILM 390 OHM 1% 1/4W
R445	40-37-1561	FXD C FILM 560 OHM 5% 1/2W
R446	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R447	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R448	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R449	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R450	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R451	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R452	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R453	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R454	44-91-3220	FXD M OXIDE 22K OHM 5% 1W

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R455	40-16-1330	FXD C FILM 330 OHM 5% 1/6
R456	44-91-3220	FXD M OXIDE 22K OHM 5% 1W
R457	40-16-1330	FXD C FILM 330 OHM 5% 1/6
R458	40-37-3391	FXD C FILM 39K OHM 5% 1/2W
R459	40-37-3391	FXD C FILM 39K OHM 5% 1/2W
R460	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R461	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R462	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R463	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R464	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R465	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R466	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R467	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R468	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R469	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R470	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R472	40-27-1182	FXD C FILM 180 OHM 5% 1/4W
R474	40-27-1182	FXD C FILM 180 OHM 5% 1/4W
R801	44-91-0270	FXD M OXIDE 27 OHM 5% 1W
R802	44-92-2270	FXD M OXIDE 2.7K OHM 5% 2W
R803	44-92-2270	FXD M OXIDE 2.7K OHM 5% 2W
R804	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R805	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R806	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R807	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R808	42-83-4115	FXD M FILM 115K OHM 1% 1/4W
R809	42-83-3100	FXD M FILM 10K OHM 1% 1/4W
R810	44-91-0010	FXD M OXIDE 1 OHM 5% 1W
R811	40-37-8262	FXD C FILM 2.2 OHM 5% 1/2W
R812	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R813	44-92-0270	FXD M OXIDE 27 OHM 5% 2W
R814	44-92-0470	FXD M OXIDE 47 OHM 5% 2W
R815	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R816	42-83-3120	FXD M FILM 12K OHM 1% 1/4W
R817	42-83-3120	FXD M FILM 12K OHM 1% 1/4W
R818	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R819	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R820	42-83-2390	FIXD M FILM 3.9K OHM 1% 1/4W
R821	42-83-2910	FIXD M FILM 9.1K OHM 1% 1/4W
R822	40-27-3682	FXD C FILM 68K OHM 5% 1/4W
R823	40-37-5471	FXD C FILM 4.7M OHM 5% 1/2W
R824	40-27-4681	FXD C FILM 680K OHM 5% 1/4W
R831	42-83-3100	FXD M FILM 10K OHM 1% 1/4W
R832	42-83-3120	FXD M FILM 12K OHM 1% 1/4W
R833	42-83-4124	FIXD M FILM 124K OHM 1% 1/4W
R834	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R835	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R836	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R837	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R838	44-91-0010	FXD M OXIDE 1 OHM 5% 1W
R841	42-34-2210	FXD M FILM 8.8M OHM 1% 2W
R842	42-44-0280	FXD M GLAZE 10M OHM 1% 1/6W
R843	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
R844	40-37-6101	FXD C FILM 10M OHM 5% 1/2W

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R845	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R846	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R847	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R848	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R849	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R850	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R851	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R852	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R853	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R854	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R855	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R856	40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R857	44-91-3330	FXD M OXIDE 33K OHM 5% 1W
R858	40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R859	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R860	40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R861	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R862	44-91-3220	FXD M OXIDE 22K OHM 5% 1W
R863	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R864	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R865	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R866	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R867	40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R868	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R869	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
R870	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
R871	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R872	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R881	40-27-3222	FXD C FILM 22K OHM 5% 1/4W
R882	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R883	40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R884	40-27-3822	FXD C FILM 82K OHM 5% 1/4W
R885	40-27-4472	FXD C FILM 470K OHM 5% 1/4W
R890	44-91-0220	FXD M OXIDE 22 OHM 5% 1W
R1165	40-16-0100	FXD C FILM 10 OHM 5% 1/6W
R1178	40-16-0220	FXD C FILM 22 OHM 5% 1/6W
R1278	40-16-0220	FXD C FILM 22 OHM 5% 1/6W
R1443	40-27-3472	FXD C FILM 47K OHM 5% 1/4W
RV110	48-33-2100	VAR M FILM 1K OHM
RV111	48-33-1100	VAR M FILM 100 OHM
RV112	48-33-2200	VAR M FILM 2K OHM
RV113	48-33-1100	VAR M FILM 100 OHM
RV114	48-33-2100	VAR M FILM 1K OHM
RV210	48-33-2100	VAR M FILM 1K OHM
RV213	48-33-1100	VAR M FILM 100 OHM
RV214	48-33-2100	VAR M FILM 1K OHM
RV401	48-33-1100	VAR M FILM 100 OHM
RV441	48-33-3200	VAR M FILM 20K OHM
RV442	48-33-2200	VAR M FILM 2K OHM
RV443	48-33-3200	VAR M FILM 20K OHM
RV801	48-33-2100	VAR M FILM 1K OHM
RV831	45-38-5100	VAR C COMP 1M OHM
RV832	45-38-4100	VAR C COMP 100K OHM

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
RV881	45-38-4200	VAR C COMP 200K OHM	
T831	63-92-0130	CONVERTOR TRANS	KIKUSUI S810115
U401	35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U402	35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U403	35-70-1121	DUAL J-K F-F	T.I SN74LS112N
U404	35-70-0471	BCD-TO-SEVEN-SEG DECO/DRI	T.I SN74LS47N
U405	35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U801	34-00-0240	DUAL OPEAMP	NEC UPC4558C
U802	34-00-0240	DUAL OPEAMP	NEC UPC4558C
U831	34-00-0215	J-FET INPUT OPEAMP	N.S LF13741N
V802	23-70-0100	LAMP NEON	
V803	23-70-0100	LAMP NEON	

A4 ASSEMBLY

C1605	50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C1606	50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C1607	52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C1608	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C1609	54-00-0114	FXD ELECT 47UF 25V	
C1610	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
CR1601	32-92-0360	ZENER VZ 35.3-36.8V	HITACHI HZ36L-2
CR1602	32-92-0360	ZENER VZ 35.3-36.8V	HITACHI HZ36L-2
CR1603	32-92-0360	ZENER VZ 35.3-36.8V	HITACHI HZ36L-2
CR1605	37-00-0061	LAMP LED GREEN	
DS1601	23-44-0000	LAMP 14V 80MA	
DS1602	23-44-0000	LAMP 14V 80MA	
P28	84-80-0370	CONNECTOR P RIGHT ANGLE	
P35	84-80-0300	CONNECTOR P RIGHT ANGLE	
P42	87-40-0040	DIAMOND CONECTOR PIN	
P43	87-40-0040	DIAMOND CONECTOR PIN	
P44	87-40-0040	DIAMOND CONECTOR PIN	
Q1601	30-31-8461	TR SI NPN	MATSUSHITA 2SC1846-R
Q1602	30-31-8461	TR SI NPN	MATSUSHITA 2SC1846-R
R1601	40-27-3332	FXD C FILM 33K OHM 5% 1/4W	
R1602	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1603	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1604	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1605	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1606	40-27-4222	FXD C FILM 220K OHM 5% 1/4W	
R1607	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R1608	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R1609	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R1610	42-83-3100	FXD M FILM 10K OHM 1% 1/4W	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
R1611		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1612		42-83-2200	FXD M FILM 2K OHM 1% 1/4W	
R1613		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1614		40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R1615		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W	
RV1601		45-44-3100	VAR C COMP 10K OHM	
RV1602		45-43-3100	VAR M GLAZE 10K OHM	
RV1603		45-44-4200	VAR C COMP 200K OHM	
RV1604		45-43-2200	VAR M GLAZE 2K OHM	
RV1605		45-44-3100	VAR C COMP 10K OHM	
RV1606		48-33-4200	VAR M FILM 200K OHM	
U1601		35-60-0000	QUAD 2-INPUT NAND GATES	TOSHIBA TC4011BP

A5 ASSEMBLY

C501		54-00-0311	FXD ELECT 10UF 50V	
C511		54-00-0311	FXD ELECT 10UF 50V	
C520	*	52-06-3010	FXD CER 1PF 500V TYPE1	
C521		54-00-0311	FXD ELECT 10UF 50V	
C522		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V	
C524		57-10-1191	VAR CER 3-10PF	
C525		57-10-1191	VAR CER 3-10PF	
C526		52-06-3145	FXD CER 22PF 10% 500V TYPE1	
C527		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V	
C528		52-06-2184	FXD CER 47PF 10% 50V TYPE1	
C529		50-67-0010	FXD PLSTC FILM 0.0022UF 10% 100V	
C530		54-00-0311	FXD ELECT 10UF 50V	
C531		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C532		54-00-0311	FXD ELECT 10UF 50V	
C533	*	52-06-3165	FXD CER 33PF 10% 500V TYPE1	
C534		52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C535		57-10-1191	VAR CER 3-10PF	
C536		52-06-3030	FXD CER 3PF 10% 500V TYPE1	
C537		52-06-3145	FXD CER 22PF 10% 500V TYPE1	
C538		52-01-3325	FXD CER 680PF 10% 500V TYPE2	
C539		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C540		52-06-2215	FXD CER 82PF 10% 500V TYPE1	
C541		52-06-2215	FXD CER 82PF 10% 500V TYPE1	
C542		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C543		55-37-2050	FXD TANT ELECT 1UF 35V	
C544		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C545		54-00-0311	FXD ELECT 10UF 50V	
C546		54-00-0114	FXD ELECT 47UF 25V	
C547		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C548		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C549		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V	
C550		52-06-3125	FXD CER 15PF 10% 500V TYPE1	
C551		54-00-0311	FXD ELECT 10UF 50V	
C552		54-00-0311	FXD ELECT 10UF 50V	
C553		55-37-2050	FXD TANT ELECT 1UF 35V	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
C554	55-37-2050	FXD TANT ELECT 1UF 35V
C555	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C556	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C557	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C558	54-00-0311	FXD ELECT 10UF 50V
C601	54-00-0311	FXD ELECT 10UF 50V
C602	54-00-0311	FXD ELECT 10UF 50V
C603	54-00-0311	FXD ELECT 10UF 50V
C604	52-06-2245	FXD CER 150PF 10% 50V TYPE1
C612	52-06-2184	FXD CER 47PF 10% 50V TYPE1
C613	50-67-0020	FXD PLSTC FILM 0.0047UF 10% 100V
C614	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C615	54-00-0121	FXD ELECT 100UF 25V
C616	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C617	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C618	52-05-1498	FXD CER 0.1UF +80-20% 25V TYPE2
C619	52-06-2265	FXD CER 220PF 10% 50V TYPE1
C620	52-06-2215	FXD CER 82PF 10% 500V TYPE1
C621	57-10-1203	VAR CER 5-20PF
C622	50-65-0540	FXD M PLSTC FILM 1UF 5% 100V
C623	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C625	52-06-3102	FXD CER 10PF 10% 500V TYPE1
C626	54-00-0311	FXD ELECT 10UF 50V
C631	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C632	54-00-0311	FXD ELECT 10UF 50V
C633	55-37-2050	FXD TANT ELECT 1UF 35V
C635	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C636	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C637	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C638	52-06-2184	FXD CER 47PF 10% 50V TYPE1
C639	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C640	52-05-1498	FXD CER 0.1UF +80-20% 25V TYPE2
C641	54-00-0311	FXD ELECT 10UF 50V
C642	54-00-0311	FXD ELECT 10UF 50V
C643	54-00-0311	FXD ELECT 10UF 50V
C644	52-06-2215	FXD CER 82PF 10% 500V TYPE1
C645	57-10-1203	VAR CER 5-20PF
C646	50-65-0540	FXD M PLSTC FILM 1UF 5% 100V
C647	52-06-3051	FXD CER 5PF 10% 500V TYPE1
C648	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C649	52-06-3051	FXD CER 5PF 10% 500V TYPE1
C650	54-00-0311	FXD ELECT 10UF 50V
C651	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C655	54-00-0311	FXD ELECT 10UF 50V
C656	54-00-0311	FXD ELECT 10UF 50V
C696	54-00-0311	FXD ELECT 10UF 50V
C697	54-00-0311	FXD ELECT 10UF 50V
C698	54-00-0311	FXD ELECT 10UF 50V
C701	52-06-2245	FXD CER 150PF 10% 50V TYPE1
C702	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C703	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C704	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C705	54-00-0311	FXD ELECT 10UF 50V
C706	52-06-2215	FXD CER 82PF 10% 500V TYPE1

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
C707	54-00-0311	FXD ELECT 10UF 50V	
C708	54-00-0311	FXD ELECT 10UF 50V	
C709	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C710	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C711	54-00-0311	FXD ELECT 10UF 50V	
C712	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C713	50-77-3500	FXD PLSTC FILM 0.047UF 20% 250V	
C714	50-77-3500	FXD PLSTC FILM 0.047UF 20% 250V	
C715	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C791	54-00-0311	FXD ELECT 10UF 50V	
C792	54-00-0311	FXD ELECT 10UF 50V	
C1537	52-06-3030	FXD CER 3PF 10% 500V TYPE1	
CR512	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR513	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR514	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR515	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR516	32-30-0860	DIODE VR 30V IO 30MA	HITACHI 1SS86
CR517	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR518	32-92-0056	ZENER VZ 5.5-5.8V P 0.4W	NEC RD5.6J
CR519	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR520	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR524	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR525	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR601	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR602	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR603	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR611	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR612	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR613	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR614	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR615	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR616	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR617	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR618	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR619	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR620	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR621	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR622	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR623	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR624	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR625	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR630	32-92-0033	ZENER VZ 3.2-3.4V	HITACHI HZ3C-2
CR631	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR632	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR633	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR634	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR635	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR636	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR637	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR638	32-30-0860	DIODE VR 30V IO 30MA	HITACHI 1SS86
CR639	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR640	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR641	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR642	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR643	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR644	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR701	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR702	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR703	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
CR704	32-11-5880	DIODE VR 30V IO 120MA	TOSHIBA 1S1588
L611	67-10-0880	INDUCTOR 2.2UH 20%	
L612	67-10-0880	INDUCTOR 2.2UH 20%	
P60	84-80-0273	CONNECTOR P FLAT WAFER	
P61	84-80-0272	CONECTOR P FLAT WAFER	
P62	84-80-0274	CONNECTOR P FLAT WAFER	
P63	84-80-0271	CONNECTOR P FLAT WAFER	
P64	84-80-0273	CONNECTOR P FLAT WAFER	
P65	84-80-0271	CONNECTOR P FLAT WAFER	
P66	87-40-0040	DIAMOND CONECTOR PIN	
P67	87-40-0040	DIAMOND CONECTOR PIN	
P68	84-80-0271	CONNECTOR P FLAT WAFER	
P69	84-80-0271	CONNECTOR P FLAT WAFER	
P70	84-80-0271	CONNECTOR P FLAT WAFER	
P71	84-80-0270	CONNECTOR P FLAT WAFER	
P72	87-40-0040	DIAMOND CONECTOR PIN	
P73	84-80-0273	CONNECTOR P FLAT WAFER	
P74	84-80-0270	CONNECTOR P FLAT WAFER	
P75	84-80-0270	CONNECTOR P FLAT WAFER	
P76	84-80-0270	CONNECTOR P FLAT WAFER	
P80	84-80-0271	CONNECTOR P FLAT WAFER	
Q511	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q512	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q513	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q514	31-20-1052	FET PAIR	KIKUSUI S8309611
Q515	31-20-1052	FET PAIR	KIKUSUI S8309611
Q516	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q517	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q518	31-20-1171	FET	TOSHIBA 2SK117-BL
Q519	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q520	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q521	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q522	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q523	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q524	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q525	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q526	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q527	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q601	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q602	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q603	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q611	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q612	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q613	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q614	30-30-9451	TR SI NPN	NEC 2SC945-Q

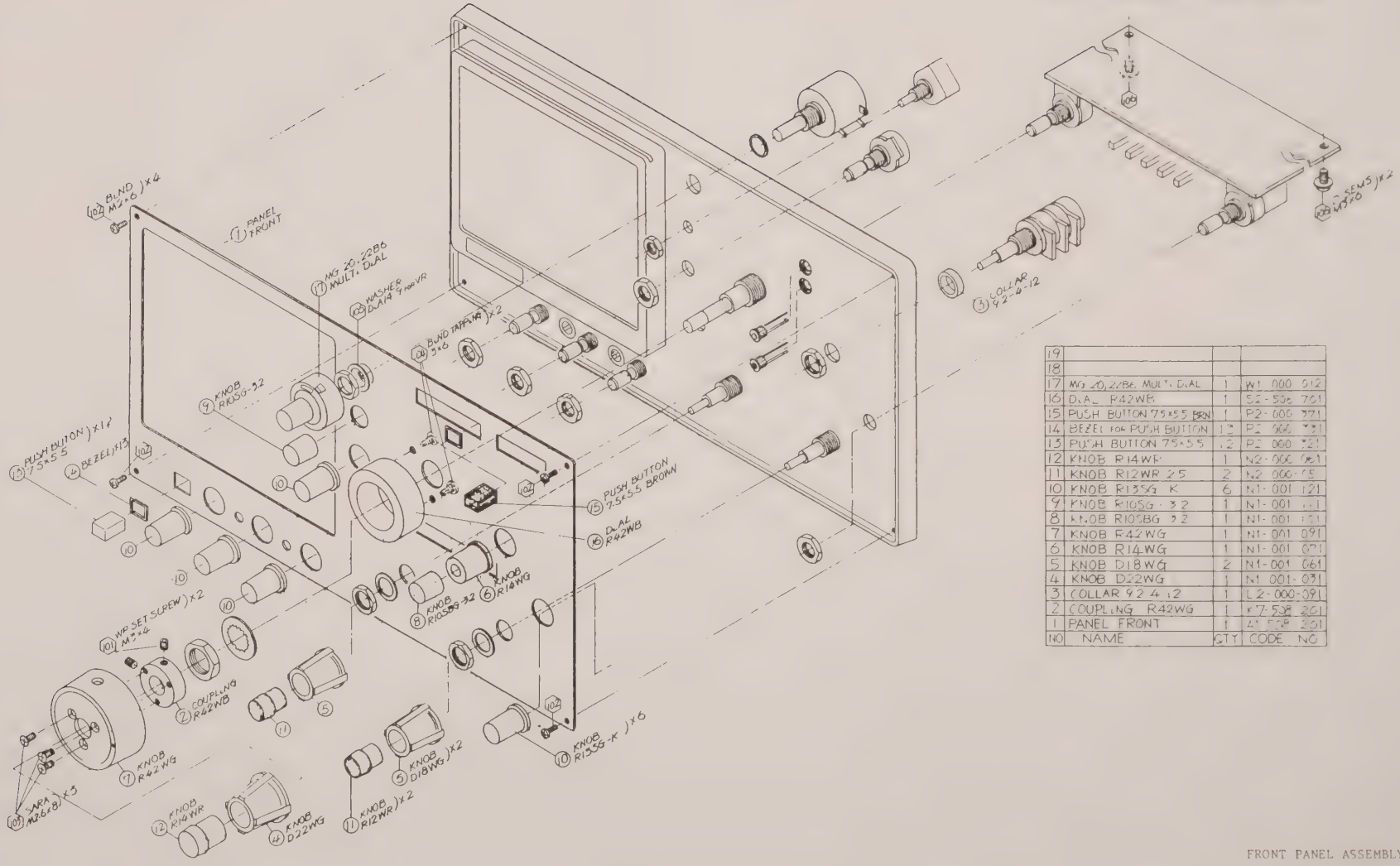
REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
Q615	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q616	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q617	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q618	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q619	30-31-3451	TR SI NPN	HITACHI 2SC1345P-E
Q620	31-20-1701	FET	TOSHIBA 2SK 170-V
Q621	31-20-1051	FET	NEC 2SK105-H
Q622	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q623	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q624	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q631	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q632	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q633	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q634	31-90-0080	DUAL FET	NEC UPA68H-M
Q635	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q636	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q637	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q638	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q639	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q640	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q641	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q642	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q643	31-20-1701	FET	TOSHIBA 2SK 170-V
Q644	31-20-1051	FET	NEC 2SK105-H
Q645	30-31-3451	TR SI NPN	HITACHI 2SC1345P-E
Q646	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q647	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q648	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q649	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q701	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q702	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q703	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q704	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q705	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q706	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q707	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q708	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q709	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q710	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q711	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q712	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q713	30-11-1441	TR SI PNP	TOSHIBA 2SA1144-O
Q714	30-32-7041	TR SI NPN	TOSHIBA 2SC2704-O
Q715	30-32-7041	TR SI NPN	TOSHIBA 2SC2704-O
Q716	30-11-1441	TR SI PNP	TOSHIBA 2SA1144-O
QCR511	30-31-9071	TR SI NPN	HITACHI 2SC1907
R510	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R511	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R512	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R519	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R520	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R521	40-27-1822	FXD C FILM 820 OHM 5% 1/4W	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
R522		40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W	
R523		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R524	*	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R525		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R526		40-27-5102	FXD C FILM 1M OHM 5% 1/4W	
R528		42-33-0430	FXD M FILM 800K OHM 1% 1/2W	
R529		42-83-4250	FXD M FILM 250K OHM 1% 1/4W	NEC 2SK105-H
R530		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R531		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R532		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R533		40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R534		40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W	
R535		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R536		40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R537		42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W	10PPM/DEG
R538		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R539		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R540		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R541		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R542		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R545		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R546		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R547		40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R548		38-00-0090	THERMISTOR 40 OHM	
R550		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R551		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R552		38-00-0090	THERMISTOR 40 OHM	
R553		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R554		40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R555		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R556		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R557		40-27-0822	FXD C FILM 82 OHM 5% 1/4W	
R558		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R559		40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W	
R560		40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W	
R561		40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R562		40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R563		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R564		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R565		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R566		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R567		40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R568		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R569		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R570		40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R571		40-27-4222	FXD C FILM 220K OHM 5% 1/4W	
R572		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R573	*	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R574		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R575		40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R576		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R577		42-83-1390	FXD M FILM 390 OHM 1% 1/4W	
R578		40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R579		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
R580		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R581		40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R582		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R583		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R584		40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R585		40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R586		40-27-3122	FXD C FILM 12K OHM 5% 1/4W
R587		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R588		40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R589		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R590		40-27-5102	FXD C FILM 1M OHM 5% 1/4W
R591		40-27-5102	FXD C FILM 1M OHM 5% 1/4W
R592		40-27-5102	FXD C FILM 1M OHM 5% 1/4W
R593		40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R594		40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R595		40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R596		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R597		40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R598		40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R599	*	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R601		40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R602		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R603		40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R604		40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R605		40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R606		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R607		40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R608		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R609		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R610		40-27-3332	FXD C FILM 33K OHM 5% 1/4W
R611		40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R612		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R613		40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R614		40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R615		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R616		40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R617		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R618		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R619		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R620		42-83-3220	FXD M FILM 22K OHM 1% 1/4W
R621		40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R622		40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R623		40-27-3222	FXD C FILM 22K OHM 5% 1/4W
R624		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R625		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R626		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R627		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R628		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R629		40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R630		40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R631		40-27-3222	FXD C FILM 22K OHM 5% 1/4W
R632		40-27-0682	FXD C FILM 68 OHM 5% 1/4W
R633		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R634		40-27-3102	FXD C FILM 10K OHM 5% 1/4W

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R635	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R636	40-27-3182	FXD C FILM 18K OHM 5% 1/4W
R637	40-27-1122	FXD C FILM 120 OHM 5% 1/4W
R638	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R639	42-83-2220	FXD M FILM 2.2K OHM 1% 1/4W
R640	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R641	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R642	40-27-3122	FXD C FILM 12K OHM 5% 1/4W
R643	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R644	42-83-3330	FXD M FILM 33K OHM 1% 1/4W
R645	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W
R650	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R651	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R652	40-27-0229	FXD C FILM 22 OHM 5% 1/4W
R653	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R654	40-27-1229	FXD C FILM 220 OHM 5% 1/4W
R655	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R656	40-27-3562	FXD C FILM 56K OHM 5% 1/4W
R657	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R658	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R660	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R661	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R662	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R663	40-27-3472	FXD C FILM 47K OHM 5% 1/4W
R664	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R665	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R666	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R667	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R668	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R669	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R670	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R671	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R672	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R673	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R674	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R675	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R676	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R677	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R678	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R679	42-83-3220	FXD M FILM 22K OHM 1% 1/4W
R680	42-83-3330	FXD M FILM 33K OHM 1% 1/4W
R681	40-27-3227	FXD C FILM 22K OHM 5% 1/4W
R682	40-27-0682	FXD C FILM 68 OHM 5% 1/4W
R683	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R684	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R685	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R686	40-27-3182	FXD C FILM 18K OHM 5% 1/4W
R687	40-27-1122	FXD C FILM 120 OHM 5% 1/4W
R688	42-83-2220	FXD M FILM 2.2K OHM 1% 1/4W
R689	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R690	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R691	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R692	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R693	42-83-3120	FXD M FILM 12K OHM 1% 1/4W

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R839	40-27-3222	FXD C FILM 22K OHM 5% 1/4W
R840	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
B3 ASSEMBLY		
RV115	45-35-3104	VAR C COMP 10K OHM
RV215	45-01-0680	VAR C COMP 10K OHM WITH SWITCH
S401	81-05-0220	PUSH SWITCH ALPS SUE50
B6 ASSEMBLY		
C2601	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
P58	84-80-0370	CONNECTOR P RIGHT ANGLE
R543	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R544	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R704	44-07-0020	FXD M GLAZE RESISTOR NETWORKS 10K OHM X4
R2601	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R2602	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
RV511	45-01-0550	VAR C COMP 10K/100K OHM B
S601	81-03-0270	PUSH SWITCH ALPS SUE30
S701	81-04-0260	PUSH SWITCH ALPS SUE40

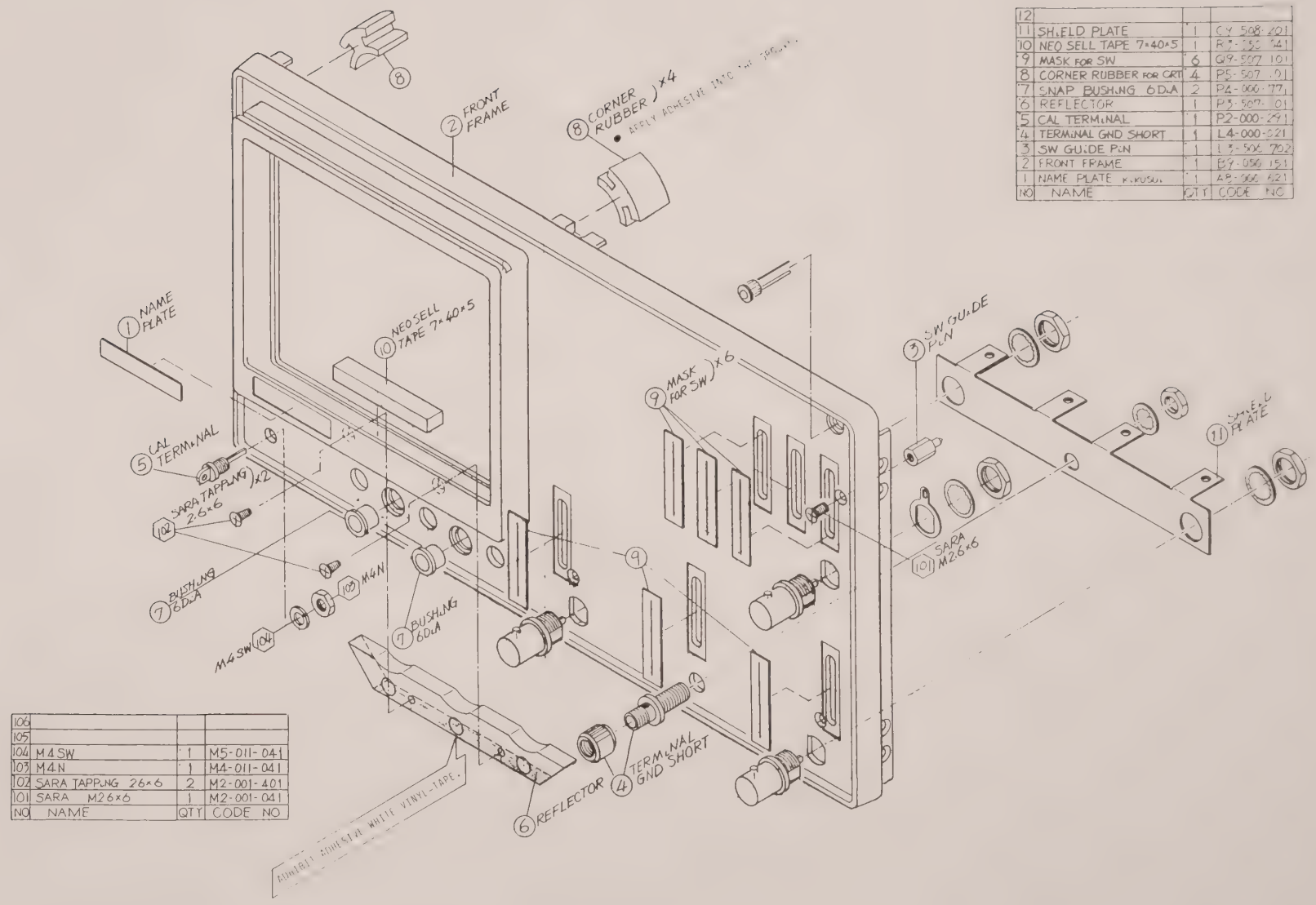


107			
106	D-SEMS M3×6	2	M3 012 011
105	WASHER DIA14-9 FOR VR	1	M3 [illegible] 351
104	BIND TAPPING 3×6	2	M2-014-011
103	SARA M2.6×8	3	M2-001-051
102	BIND M2×6 S-Ni	4	M2 [illegible] 601
101	WP SET SCREW M3×4	2	M1 002 011
NO	NAME	QTY	CODE NO

19			
18			
17	MG 20,22Be MULT. DIAL	1	W1 000 512
16	DIAL R42WB	1	S2-536 701
15	PUSH BUTTON 7.5×5.5 BRN	1	P2-000 371
14	BEZEL for PUSH BUTTON	1.3	P2 [illegible] 331
13	PUSH BUTTON 7.5×5.5	1.2	P2 000 321
12	KNOB R14WR	1	N2-000 [illegible]
11	KNOB R12WR 2.5	2	N2 000 [illegible]
10	KNOB R13SG K	6	N1-001 121
9	KNOB R10SG-32	1	N1-001 [illegible]
8	KNOB R10SBG 3.2	1	N1-001 [illegible]
7	KNOB R42WG	1	N1-001 091
6	KNOB R14WG	1	N1-001 071
5	KNOB D18WG	2	N1-001 061
4	KNOB D22WG	1	N1 001-031
3	COLLAR 9.2 4 12	1	L2-000-091
2	COUPLING R42WG	1	K7-538 201
1	PANEL FRONT	1	A1 [illegible] 201
NO	NAME	QTY	CODE NO

FRONT PANEL ASSEMBLY

317443

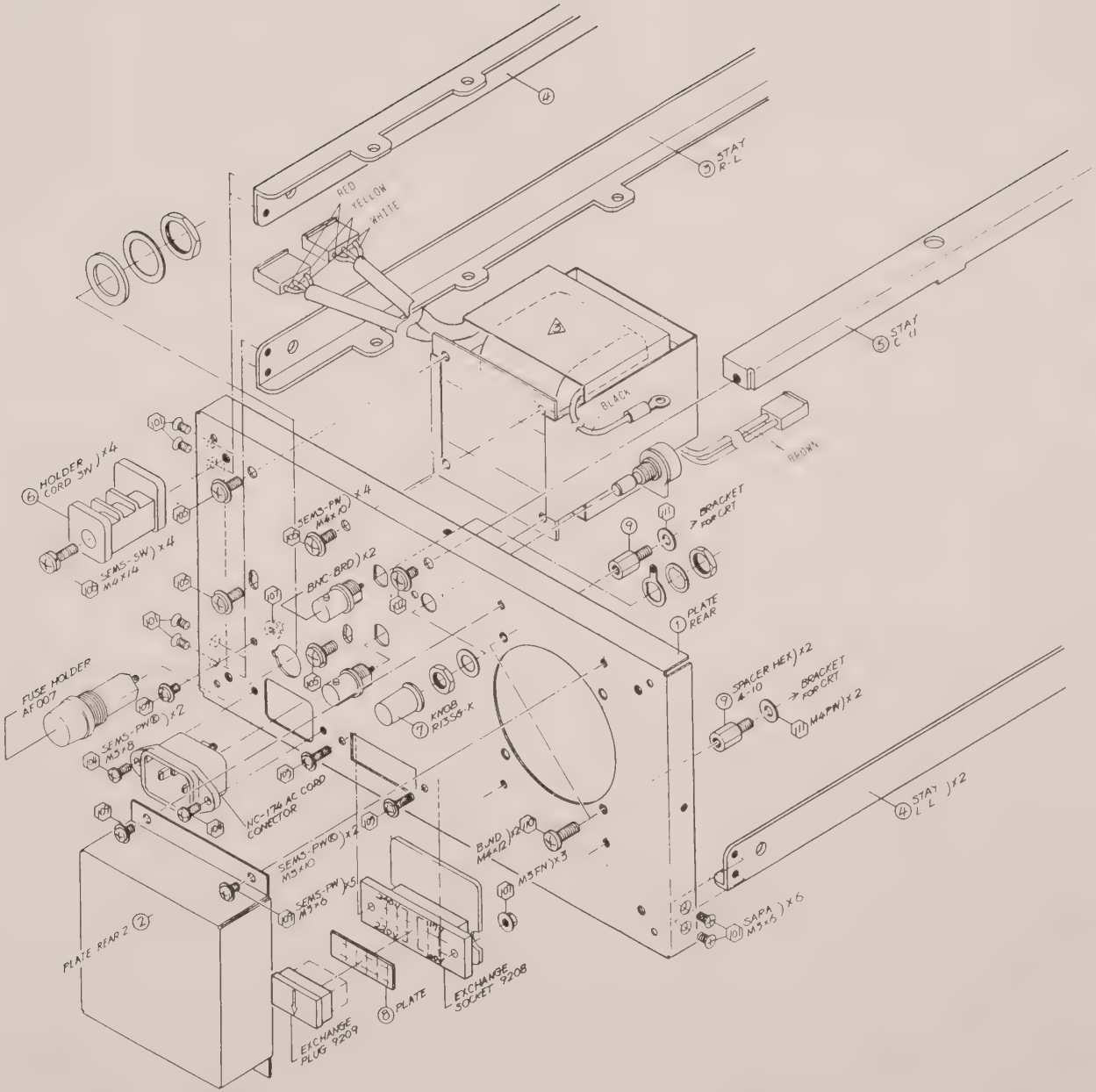


NO	NAME	QTY	CODE NO
12			
11	SHIELD PLATE	1	C4-508-201
10	NEO SELL TAPE 7×40×5	1	R2-152-341
9	MASK FOR SW	6	G9-507-101
8	CORNER RUBBER FOR CRT	4	P5-507-101
7	SNAP BUSHING 6DIA	2	P4-000-771
6	REFLECTOR	1	P3-507-101
5	CAL TERMINAL	1	P2-000-291
4	TERMINAL GND SHORT	1	L4-000-021
3	SW GUIDE PIN	1	L3-504-702
2	FRONT FRAME	1	B7-050-151
1	NAME PLATE KIKUSUI	1	A8-900-621

NO	NAME	QTY	CODE NO
106			
105			
104	M4SW	1	M5-011-041
103	M4N	1	M4-011-041
102	SARA TAPPING 26×6	2	M2-001-401
101	SARA M26×6	1	M2-001-041

FRONT FRAME ASSEMBLY

317444



NO	NAME	QTY	CODE NO
111	M4PW	2	M4-000-041
110	BIND M4×12	2	M4-000-191
109	SEMS-PW M3×6	5	M3-000-011
108			
107	M3FN	3	M4-010-021
106	SEMS-SW M4×14	4	M3-011-161
105	SEMS-PW M4×10	4	M3-000-061
104	SEMS-PW M3×8	2	M3-000-041
103	SEMS-PW M3×10	2	M3-000-051
102	SEMS-PW M4×8	1	M3-000-021
101	SARA M3×6	6	M2-001-081

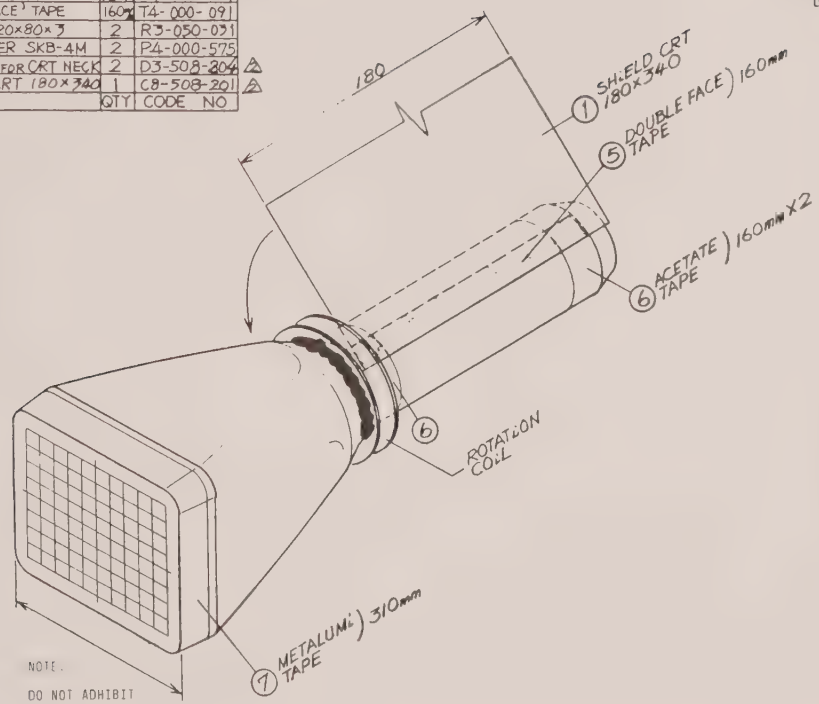
NO	NAME	QTY	CODE NO
10			
9	SPACER HEX 4-10	2	[illegible]-528-20
8	PLATE VOLTAGE SELECTOR	1	G2-000-191
7	KNOB R13S6-K	1	M4-001-121
6	HOLDER CORD 3W	4	P3-000-101
5	STAY C-U	1	D5-507-[illegible]
4	STAY L-L	2	D5-507-102
3	STAY R-L	1	D5-507-101
2	PLATE REAR-2	1	B6-507-802
1	PLATE REAR	1	B6-[illegible]-201

REAR PLATE ASSEMBLY

317445

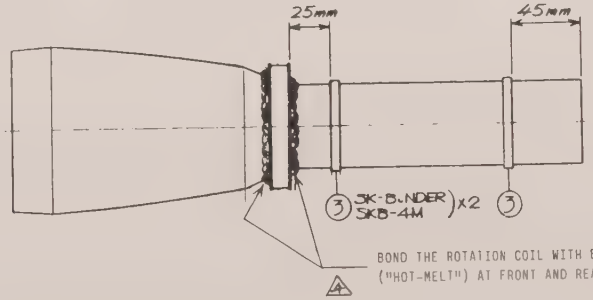
NO	NAME	QTY	CODE NO
9			
8			
7	METALUMI' TAPE	310%	T4-000-181
6	'ACETATE' TAPE	320%	T4-000-131
5	'DOUBLE FACE' TAPE	160%	T4-000-091
4	SPACER 20×80×3	2	R3-050-031
3	SK-BINDER SKB-4M	2	P4-000-575
2	BRACKET FOR CRT NECK	2	D3-508-304 ⚠
1	SHIELD CRT 180×340	1	C8-508-201 ⚠

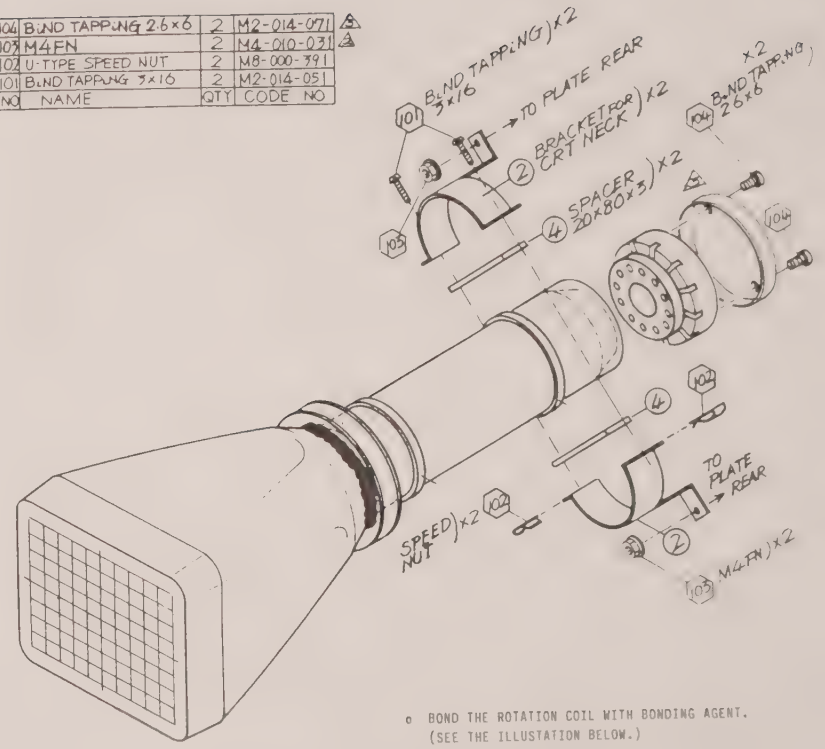
NO	NAME	QTY	CODE NO
106	BIND TAPPING 2.6×6	2	M2-014-071 ⚠
103	M4FN	2	M4-010-031 ⚠
102	U-TYPE SPEED NUT	2	M8-000-391
101	BIND TAPPING 3×16	2	M2-014-051



NOTE.

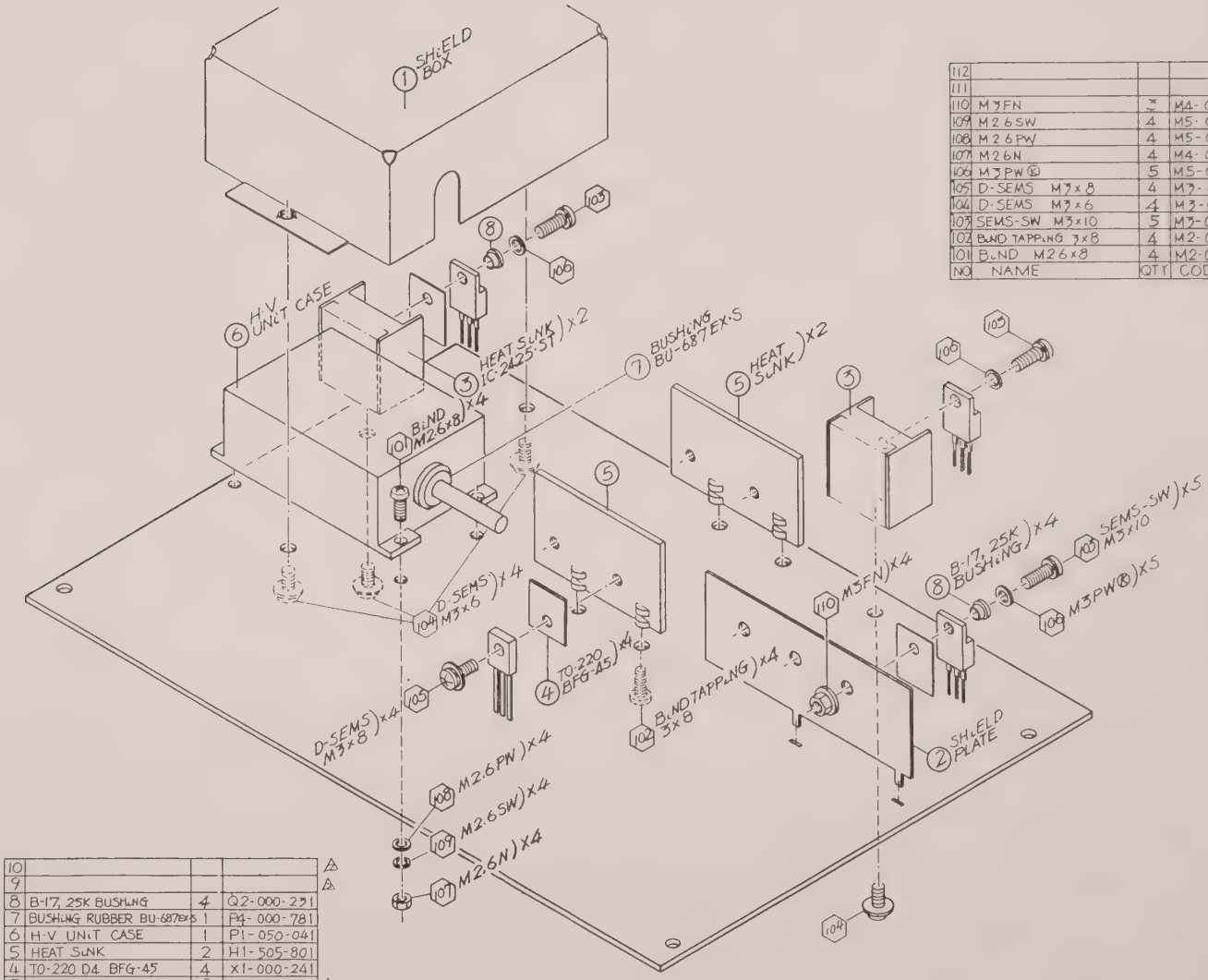
DO NOT ADHIBIT "METALUMI" TAPE IN THIS SPAN. (APPROX. 120 mm)





- BOND THE ROTATION COIL WITH BONDING AGENT. (SEE THE ILLUSTATION BELOW.)
- BIND THE CRT NECK WITH ACETATE TAPE AT TWO POSITIONS AS ILLUSTRATED.
- POST DOUBLE FACE TAPE (BOTH-FACE-ADHESIVE TAPE) AS ILLUSTRATED.
- PUT THE END OF SHIELD CRT (CRT SHIELDING SHEET) ON THE END OF DOUBLE FACE TAPE AND WIND THE SHEET ON CRT NECK, EXERCISING CARE TO ELIMINATE GAPS.
- FIX THE CRT NECK BRACKETS WITH TWO SK BINDERS (TAPPING SCREWS) AS ILLUSTRATED.
- WHEN ASSEMBLED, THE CRT NECK BRACKETS SHOULD BE SHIFTED BY 90 DEGREES OF ANGLE FROM THE ILLUSTRATED POSITION.

CRT ASSEMBLY

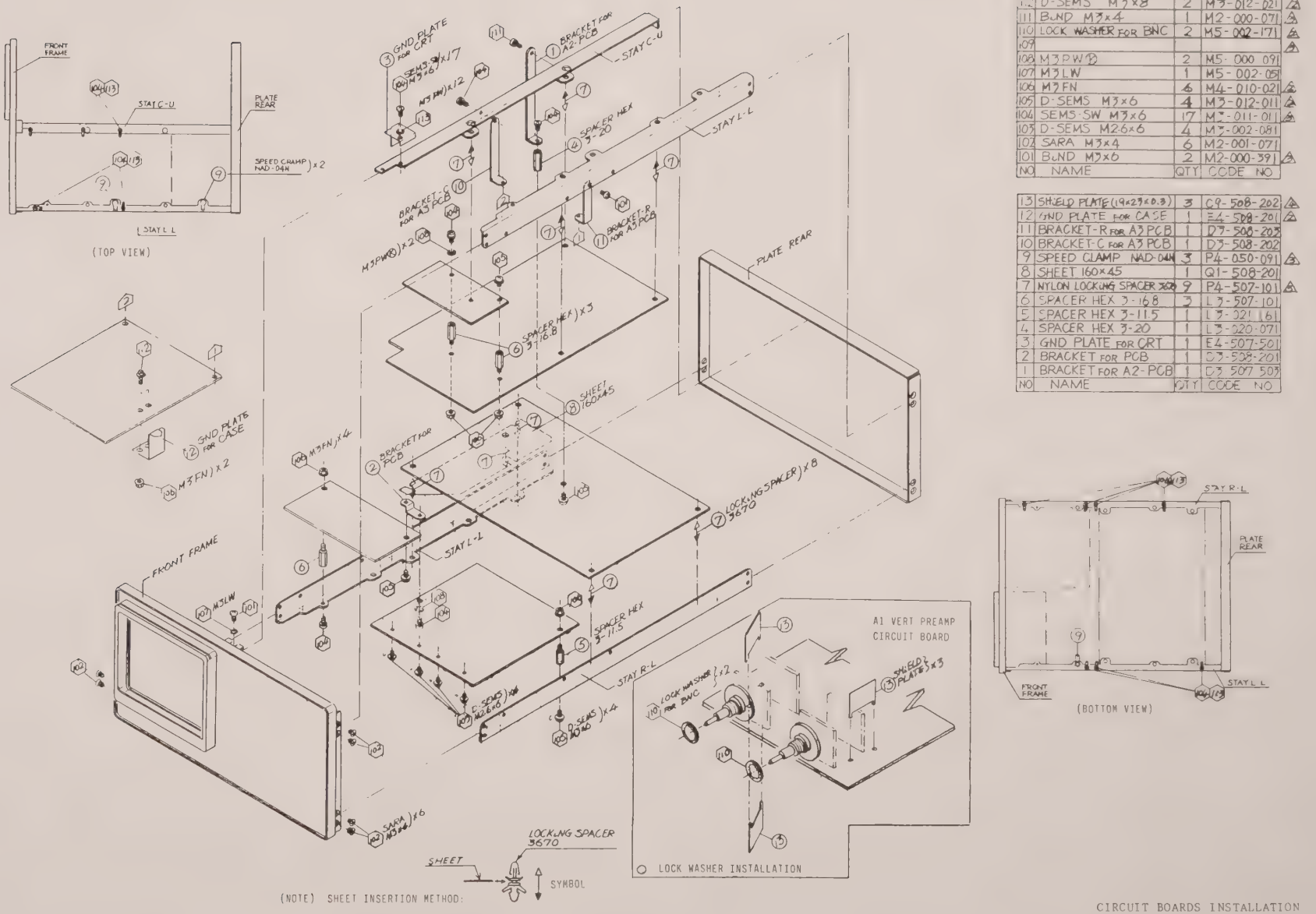


NO	NAME	QTY	CODE NO	
112				
111				
110	M3FN	4	M4-010-021	⚠
109	M2.6SW	4	M5-001-021	
108	M2.6PW	4	M5-000-021	
107	M2.6N	4	M4-000-021	
106	M3PW ⓔ	5	M5-000-091	
105	D-SEMS M3x8	4	M3-012-021	
104	D-SEMS M3x6	4	M3-012-011	
103	SEMS-SW M3x10	5	M3-011-031	
102	BIND TAPPING 3x8	4	M2-014-021	
101	BIND M2.6x8	4	M2-000-051	

NO	NAME	QTY	CODE NO	
10				⚠
9				⚠
8	B-17, 25K BUSHING	4	Q2-000-231	
7	BUSHING RUBBER BU-687EX-S	1	P4-000-781	
6	H.V. UNIT CASE	1	P1-050-041	
5	HEAT SINK	2	H1-505-801	
4	TO-220 D4 BFG-45	4	X1-000-241	
3	IC-2425-ST HEAT SINK	2	H2-000-181	⚠
2	SHIELD PLATE	1	C9-050-131	
1	SHIELD BOX	1	C8-508-001	

CIRCUIT BOARD ASSEMBLY
(VERTICAL)

317447



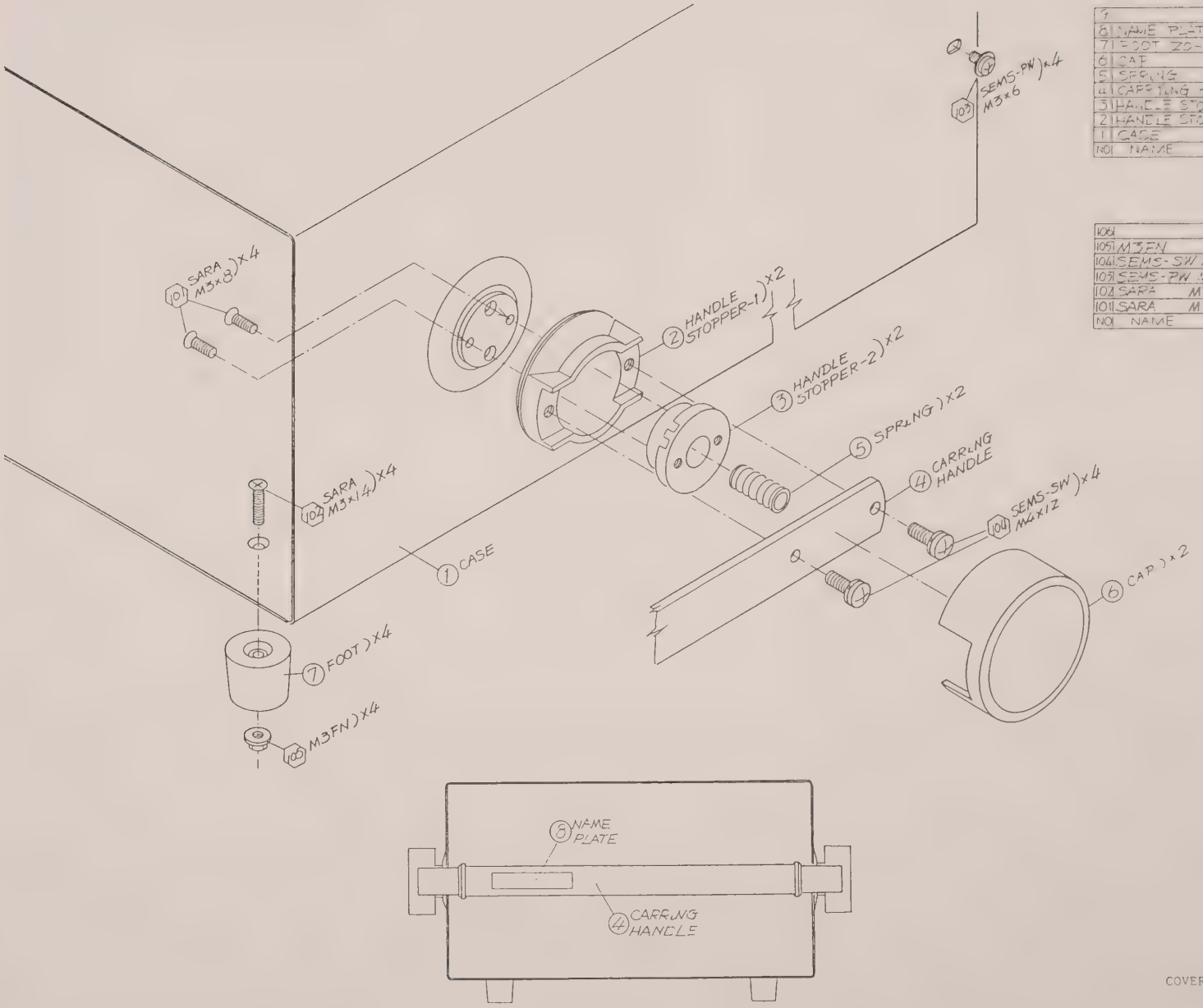
NO	NAME	QTY	CODE NO	
113	M3 PW	12	M5-000-031	A
112	D-SEMS M3×8	2	M3-012-021	A
111	BIND M3×4	1	M2-000-071	A
110	LOCK WASHER FOR BNC	2	M5-002-171	A
109				A
108	M3 PW (P)	2	M5-000-091	
107	M3 LW	1	M5-002-051	
106	M3 FN	6	M4-010-021	A
105	D-SEMS M3×6	4	M3-012-011	A
104	SEMS-SW M3×6	17	M3-011-011	A
103	D-SEMS M2.6×6	4	M3-002-081	
102	SARA M3×4	6	M2-001-071	
101	BIND M3×6	2	M2-000-391	A

NO	NAME	QTY	CODE NO	
13	SHIELD PLATE (149×29×0.3)	3	C9-508-202	A
12	GND PLATE FOR CASE	1	E4-508-201	A
11	BRACKET-R FOR A3 PCB	1	D3-508-203	
10	BRACKET-C FOR A3 PCB	1	D3-508-202	
9	SPEED CLAMP NAD-04H	3	P4-050-091	A
8	SHEET 160×45	1	Q1-508-201	
7	NYLON LOCKING SPACER 3670	9	P4-507-101	A
6	SPACER HEX 3-16.8	3	L3-507-101	
5	SPACER HEX 3-11.5	1	L3-321-161	
4	SPACER HEX 3-20	1	L3-320-071	
3	GND PLATE FOR CRT	1	E4-507-501	
2	BRACKET FOR PCB	1	D3-508-201	
1	BRACKET FOR A2-PCB	1	D3-507-503	

(NOTE) SHEET INSERTION METHOD:

INSERT SLIT OF SHEET INTO GAP AT WAIST OF LOCKING SPACER.

CIRCUIT BOARDS INSTALLATION



NO	NAME	QTY	CODE NO
8	NAME PLATE <KW-2>	1	A5-002-F*
7	FOOT 20-17	4	P*-***-**
6	CAP	2	P*-***-01
5	SPRING	2	L5-***-01
4	CARRYING HANDLE	1	E6-***-01
3	HANDLE STOPPER-2	2	E6-***-02
2	HANDLE STOPPER-1	2	E6-***-06
1	CASE	1	B1-***-**
NO	NAME	QTY	CODE NO

NO	NAME	QTY	CODE NO
106			
105	M3FN	4	M4-010-02
104	SEMS-SW M4x12	4	M*-***-09
103	SEMS-PW M3x6	4	M3-***-01
102	SARA M3x14	4	M2-001-39
101	SARA M3x8	4	M2-001-09

COVER & HANDLE ASSEMBLY

317449

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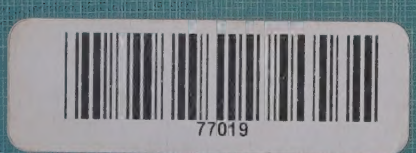
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